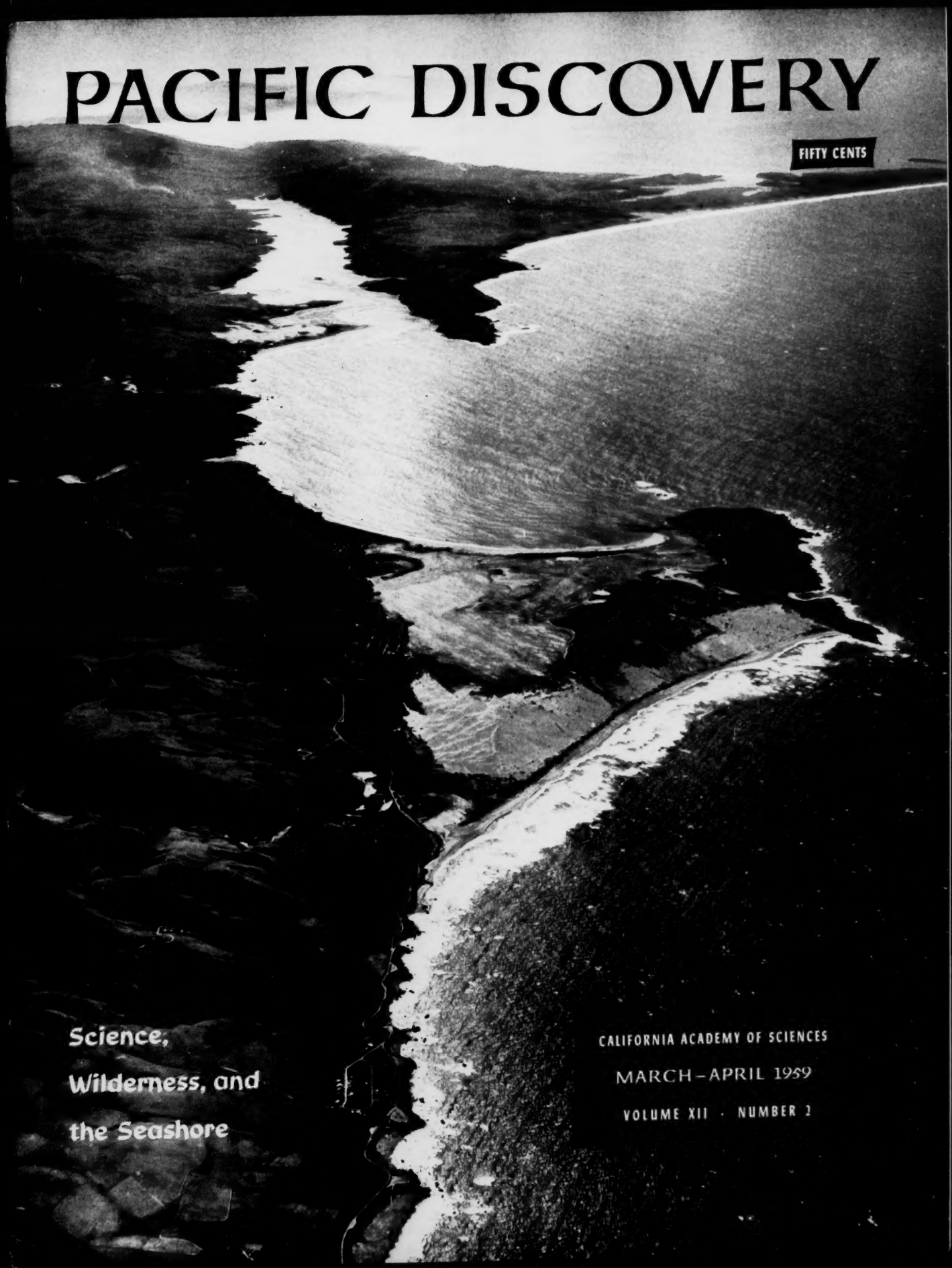
PACIFIC DISCOVERY

FIFTY CENTS



Science, Wilderness, and the Seashore

CALIFORNIA ACADEMY OF SCIENCES

MARCH–APRIL 1959

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PRE-DISCOVERY

"OF GREATER POTENTIAL IMPORTANCE to Twentieth Century man than the cracking of the atom or the exploration of space is the solution of the world's problem of conservation of natural resources in the face of a fantastic and apparently continuing increase in human population." This carefully worded sentence concludes Walter P. Taylor's report in the *Sierra Club Bulletin* of February 1959 on the Sixth General Assembly of the International Union for the Conservation of Nature and Natural Resources, held in Athens last September. A less careful man than Mr. Taylor might have omitted the qualifiers "potential" and "apparently." No doubt our top atomic brass would rush in with a "nothing to worry about—atomic energy is just around the corner with the answers to all our resources problems." As for space exploration: we are not ag'in' it—until it becomes a convenient escape from our most awkward terrestrial dilemmas. But when it comes to population increase, we're ag'in' it with everything we've got—especially on the days when we've had to fight our way onto or off a "freeway" or find a downtown parking place (*must* we have two new autos for every one new people?). Ah, wilderness. . . . The same SC *Bulletin* quotes the 1958 Annual Report of Resources for the Future quoting John Stuart Mill, a philosophical gentleman, as saying—one hundred years ago: "It is not good for man to be kept perforce at all times in the presence of his species. A world from which solitude is extirpated is a very poor ideal. . . . Nor is there much satisfaction in contemplating the world with nothing left to the spontaneous activity of nature; with every rood of land brought into cultivation which is capable of growing food for human beings; every flowery waste or natural pasture ploughed up, all quadrupeds or birds which are not domesticated for man's use exterminated as his rivals for food, every hedgerow or superfluous tree rooted out, and scarcely a place left where a wild shrub or flower could grow without being eradicated as a weed in the name of improved agriculture." In this space last issue we announced the Sierra Club-sponsored Sixth Biennial Wilderness Conference, in San Francisco, March 20–21. The passage from Mill could well be taken as the text under which scientists, conservationists, park and forest men, and many others, will seek some of the answers to threats of a hideously overcrowded world. And at Asilomar, California, same week-end, the Audubon Biennial Convention will be considering ways and means to the fuller enjoyment of nature. We'll be there, too!

PD'S AUTHORS

CHAIRMAN OF THE WILDERNESS CONFERENCE, **Dr. Robert C. Miller,** Director of the California Academy of Sciences, editorializes on the Conference theme, "The Meaning of Wilderness to Science" (the editor is responsible for the change of title) . . . ¶ **Arthur C. Smith** is senior vector control specialist in the California Department of Public Health, Berkeley, about two blocks from the University of California Press where the first volumes of the new California Natural History Guides (see advt., p. 31) are now in press under his editorship. Thanks to him and to the Press for the privilege of advance-running part of his *Introduction to the Natural History of the Bay Region*. . . . ¶ Librarian of the Sutro Library of the State of California located in San Francisco, **Richard H. Dillon** finds a smörgasbord of plain and natural history tidbits on his shelves. The current item smacks of Monterey and Carmel, Audubon-boners please note. . . . ¶ Writer-photographer **John Warham** is an Englishman who, with his wife, has been wandering around Australia for six years studying the wildlife. The mutton bird story stems from a five-month stay on uninhabited (by humankind) Cat Island in the Furneaux Group off Tasmania. . . . ¶ As Director of the College of the Pacific's Pacific Marine Station at Dillon Beach, Marin County, **Dr. Joel W. Hedgpeth** keeps a watchful eye upwind to Bodega Head and the threat of an atomic power plant there. . . . ¶ **Annette Richards Parent** and her husband Hiram are managing the Ghost Ranch Museum in New Mexico. . . . ¶ **George W. Bunton,** Academy curator of astronomy, manages the Alexander F. Morrison Planetarium. D.G.K.

IN THIS ISSUE

THE COVER

BODEGA HEAD, Harbor, and Bay, looking south toward Tomales Bay, with Point Reyes just off the upper right. Aerial photo by William A. Garnett, shooting past the wing-tip with *PD's* editor clinging to the other side of the two-seater's cabin *(see page 16)*.

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A JOURNAL OF NATURE AND MAN IN THE PACIFIC WORLD

EDITORIAL

SCIENCE NEEDS SOME WILDERNESS

IT IS COMMONLY said that man is the only animal that uses tools, also that man is the only animal that has power to change his own environment. Neither of these statements is true.

A digger wasp uses a pebble to tamp down the earth over its buried incubator. A Galapagos finch takes a thorn in its bill to pry reluctant insects out of the crevices in which they are hiding. (This use of a tool by a bird was first observed on the Academy's expedition to the Galapagos Islands in 1905–06 by Edward W. Gifford, whose eyewitness account was regarded with considerable skepticism until David Lack in 1940 recorded the phenomenon in motion pictures exactly as Gifford had described it.) Undoubtedly other examples of the use of tools by animals could be cited. Nobody, to our knowledge, has made a serious study of this.

As regards modification of the environment, all animals and even plants exercise this ability in some degree. Ants cultivate aphids for the honeydew they produce much as we raise dairy cattle, and they transport the aphids to new pastures. Woodpeckers bore holes in trees to make their nests. Beavers fell trees, build dams and store water. Burrowing animals – ground squirrels, pocket gophers, moles, earthworms–are important agents in soil-improvement, turning over and aerating the soil, and facilitating penetration of rainfall.

Birds and animals are important agencies in distributing the seeds of plants. Plants themselves, in the very process of their growth, modify the water content and the chemistry of the soil in which they grow. A tree by its shade prevents many kinds of plants from growing beneath it, and encourages others which thrive in a shady environment.

Man is not the only organism that damages the area in which it lives. The gypsy moth, the tent caterpillar, the white-pine blister rust, the chestnut blight, each in its own way does a thorough job. Some even appear to work against their own interests. The oak-leaf moth in California, in years when it is abundant, so completely denudes the live oaks that the last brood has no leaves on which to feed, and thus mostly dies of starvation. Only a few individuals survive, and it takes several years for the population to build up again to a destructive level. (Human beings could learn important lessons from their lowlier companions in the struggle for existence, but they won't.)

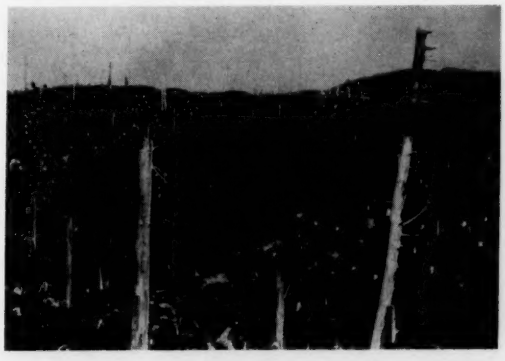
Man is, of all known forms of life, the most versatile, the most ingenious, the most effective and the most permanent in his influence on the face of nature. Wherever he penetrates in numbers, forests are cut down, land is brought under cultivation, swamps are drained, dams are built, cities spring up, highways dissect the landscape, airfields are constructed, and shortly both highways and airlanes are crowded with machines, producing noise and smog.

No one but a misanthrope would maintain that modern civilization is of itself an evil. Miracles have been wrought in prolonging life, improving health, alleviating grinding toil, and providing comfort, convenience, and that margin of leisure that is felt to be necessary to the pursuit of the good life. But none except the fatuous would claim that man's conquest of his environment has been uniformly in the right direction.

Biologists in particular have the problem of dealing with unforeseen consequences of changes man has brought about in the natural order. They are asked to restore fish to our streams, and to save vanishing species of birds and animals. On the other hand they are asked to control species that have become too abundant through reduction of their natural enemies, e.g., killing of predators. It cannot be too strongly emphasized that the only way the biologist can make sound recommendations is through the study of these species in their natural environment.

Wilderness is not to be confused with wasteland. It is not sufficient to have large areas of mountain and desert set aside as wilderness because they are of little use for anything else. We need wilderness areas of coniferous and of hardwood forests, and of ocean shore, and of meadow and prairie. In particular we need to save the very few remaining pieces of arable land untouched by the plow. Even small samples are better than none.

Wilderness areas, with limited access, are clearly of the highest importance to science as *standards of reference* – natural laboratories to which biologists of today and of the future can repair to answer the recurring question, "What was the natural order–what was the situation before man changed it?" R.C.M.



This *was* a wilderness.

ARTHUR C. SMITH

THE SAN F

ON THE California Natural History Guides the bay region is arbitrarily designated as the nine counties bordering San Francisco Bay plus Santa Cruz County.

Although the entire bay is generally called San Francisco Bay, the north part is known as San Pablo Bay, and its narrow easterly extension beyond Carquinez Strait as Suisun Bay.

The bay opens to the Pacific Ocean through the Golden Gate; covers a total area of some 900 square miles extending from Treasure Island approximately 30 miles to the southeast and 20 miles to the north; and reaches eastward from San Pablo Bay some 30 miles through Carquinez Strait along the drowned river valley of the Sacramento—San Joaquin rivers.

The bay varies from 3 to 13 miles in width (narrowing to half a mile at Carquinez Strait) with the main channel from 20 to 60 feet deep south of the Bay Bridge; from 30 to 130 feet deep between Treasure Island and Angel Island; from 220 to 357 feet deep beneath Golden Gate Bridge; varying from 20 to 54 feet from Treasure Island to San Pablo Strait; and with a maximum channel depth of 34 feet in San Pablo Bay (most of which is less than 10 feet deep). Carquinez Strait varies in depth from 94 feet at Carquinez Bridge to 38 feet at Martinez Yacht Harbor.

A number of small islands rise in the bay, mostly in the area bounded by the three major bridges.

The San Francisco and Marin peninsulas enclose the bay from the west, with Mount Tamalpais (2,604 ft.) dominating the Marin Peninsula and the Montara and northern extension of the Santa Cruz Mountains rising back of the San Francisco Peninsula cities.

To the south of the bay lies the Santa Clara Valley, with the Santa Cruz Mountains on the west and the Mount Hamilton Range (a part of the Diablo Range) on the east. Mount Hamilton (4,209 ft.) dominates the eastern mountains. Loma Prieta (3,798 ft.) and Black Mountain (2,810 ft.) are two of the most prominent peaks seen west of the valley.

North of the bay a series of valleys and ridges parallels the coastline, with Mount St. Helena (4,344 ft.) rising at the head of the Napa Valley.

In Sonoma County north of Russian River a part of the eroded Mendocino Plateau enters our area.

The Berkeley Hills rise behind the East Bay cities, with paralleling ridges to the south and east. The Diablo Range extends from Mount Diablo (3,849 ft.) in Contra Costa County to just south of Pacheco Pass in Santa Clara County.

A part of the Great Central Valley enters the bay region in eastern Contra Costa and Solano counties.

There are no natural fresh-water lakes of any size in the area, but there are many reservoirs in the hills and mountains encircling the valleys. Most bay region streams are intermittent (dry for part of the year). Among the permanent streams are the San Joaquin River, Sacramento River, Russian River, Napa River, San Lorenzo River, Boulder Creek, Pescadero Creek, and Lagunitas Creek.

Climate

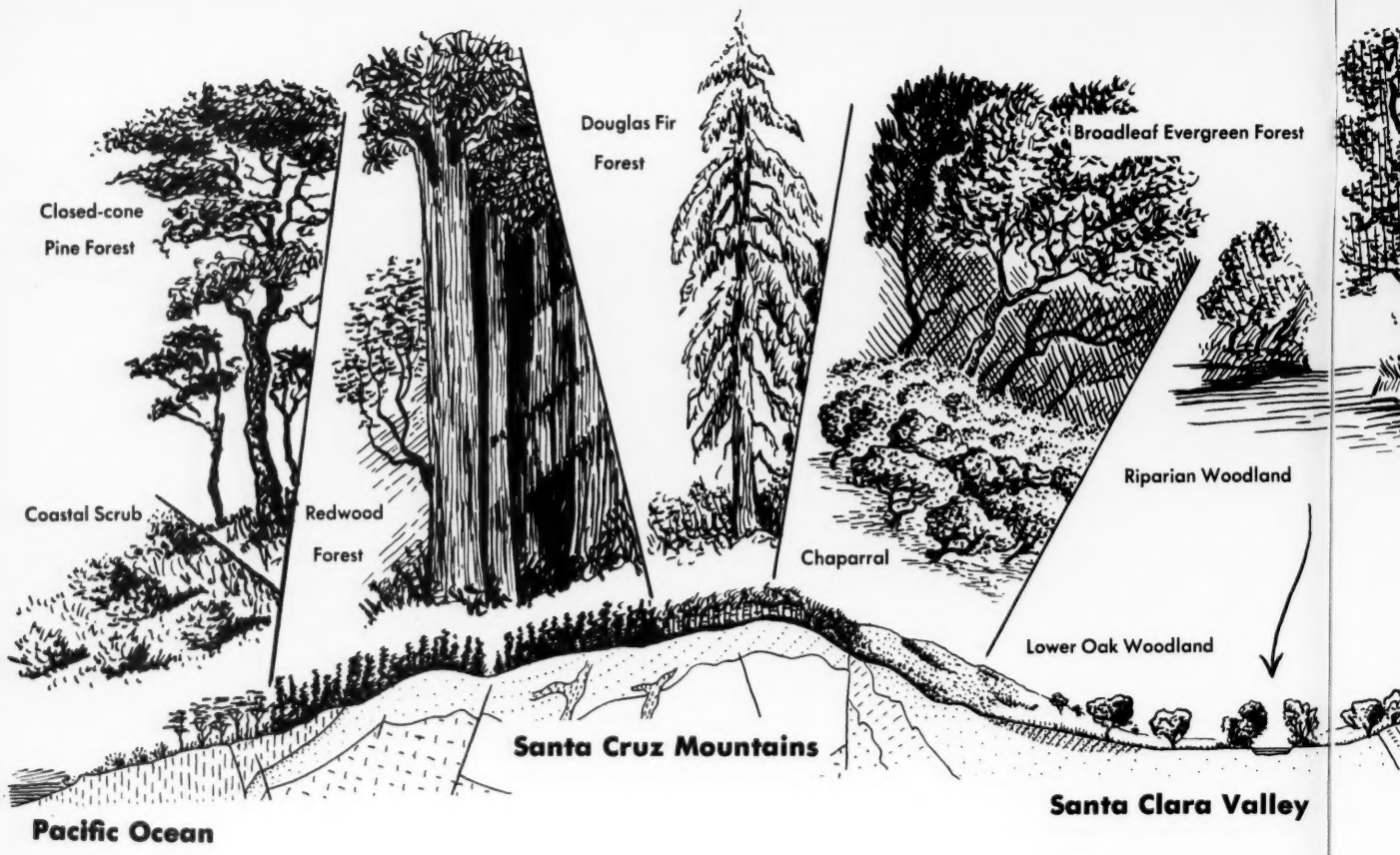
The climate is mild, with long dry summers cooled near the coast by fog; warm to hot east of the north-south mountain ranges wherever the fog does not penetrate. The winters are relatively warm near the coast, but quite cool higher in the mountains and east of the Vaca Mountains, Berkeley Hills, and Diablo Range.

For the entire area the average annual temperature is 57° F., with an average maximum of 69 and an average minimum of 46. The growing season (last killing frost to the first killing frost) varies from an average minimum of 180 days at the summit of Mount Hamilton to an average maximum of 362 days at Point Reyes.

Most of the rain falls during the winter months, with the greatest amount for a single month usually in January. Mean annual precipitation north of the bay is approximately 33 inches and south of the bay 20 inches. At Mount St. Helena mean annual precipitation reaches 59.5 inches and in

The animal drawings by William D. Berry, made for a volume in the California Natural History Guides series, are reproduced by courtesy of the University of California Press, Berkeley. The chart is a reduced portion of C.&G.S. 5021, "Monterey Bay to Coos Bay."

N FRANCISCO BAY REGION



the Santa Cruz Mountains 44.8 inches, but in the valleys east of the crest of Diablo Range as little as 10 to 14 inches.

Snow and hail, except on the highest peaks, are rare and unimportant in the bay region. Two important climatic factors are fog and cloud cover. Since they act as screens to reduce the amount of sunshine, they affect the temperature, rate of evaporation, and relative humidity. Fog and cloud cover seem to be necessary to some plants and of great importance to some animals, and thus these climatic factors play a part in determining the kinds and numbers of terrestrial plants and animals living in this area. The mean annual cloudiness in the bay region is between 50 and 60 per cent, with more than 70 per cent in northern Sonoma County along the coast but less than 40 per cent in the inner coastal ranges.

Seasons

Obviously the seasons of the year do not have the same meaning in the bay region that they have, for example, in New England or the Middle West. Climate alone might indicate just two seasons—wet and dry—but nature itself, through the plants and animals, gives abundant evidence of the changing seasons. However, the seasons in California can be only loosely correlated with the calendar seasons, because many of the significant

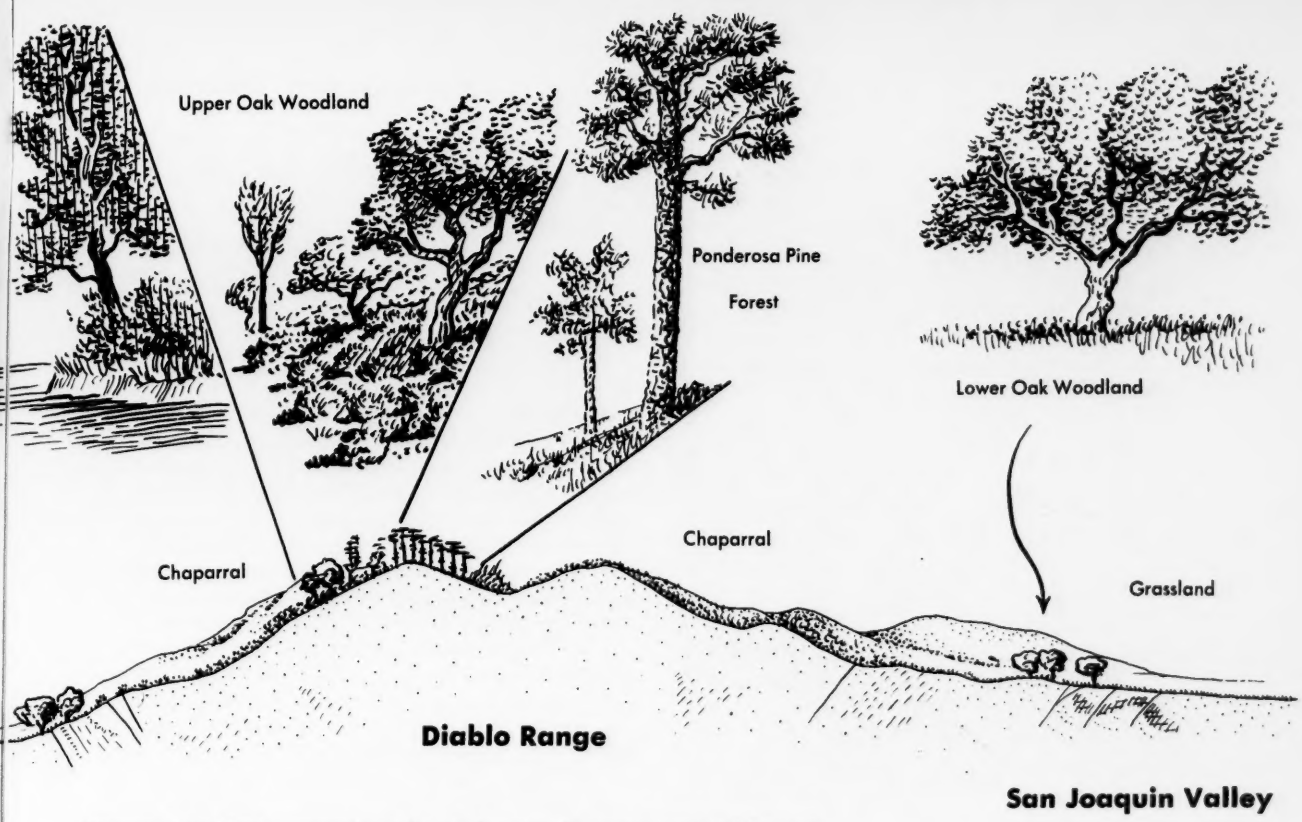


Diagram of the biotic communities of the San Francisco Bay region, west (*left*) to east. (From *Introduction to the Natural History of the Bay Region*, by Arthur C. Smith; drawn by Gene M. Christman; University of California Press, Berkeley and Los Angeles, 1959)

seasonal events may take place from a few weeks to several months earlier or later than usual in response to climatic variations.

Spring.—The grass cover is green as spring starts, but soon turns brown (except in the foggiest areas, where it may remain green until fall) unless there are unusual spring rains. Migratory birds are enroute north, large flocks of House Finches and blackbirds break up into pairs, nesting of birds begins, and bird singing is at the peak of intensity. Mass blooming of early wild flowers is a conspicuous sign of spring. The Sara Orange-Tip and Common Checkerspot butterflies are on the wing. With warm days, lizards resume activities and insects become plentiful.

Summer.—The grass cover is now uniformly

brown except near water and in areas of continuous summer fog. There is general rearing of young by resident birds. The intensity of bird songs declines as summer progresses, and migratory shore birds are on the way south by the middle or end of summer. Late-blooming wild flowers are now at their peak. The California Buckeye loses its leaves by mid-summer and its naked, scraggly form stands out conspicuously on the hillsides until the other deciduous trees lose their leaves in the fall. Fritillaries, satyrs, and alfalfa butterflies are in flight.

Fall.—The grass cover remains brown generally and now turns brown in areas kept green by fog through the summer. Bird songs are at a minimum, with House Finches and blackbirds again flocking. Migratory waterfowl return to the marshes and bays. Few wild flowers are blooming, but the blue blossoms of Chicory are still conspicuous along many roadsides. Coyote Brush is in full bloom along highways and on hillsides throughout much of the area. Monarch Butterflies migrate southward, and cocoons of native silk moths are formed on cherry and plum trees, wild cherry, wild lilac, and California Coffee Berry. With the first showers, two animal groups respond as if by magic. Termites invariably take off on a mating flight and start new colonies, and salamanders come out of hiding to resume activities. With heavy, soaking rains, pleocoma June beetles emerge from the ground and may be seen buzzing along in the rain less than a foot above the ground.

Winter.—In the bay region, nature's "great reawakening" usually takes place in winter rather than in spring. With the first heavy rains fresh green shoots of grass start pushing through last season's dry brown cover, and usually by mid-January central California's hills are again a lush green. Fruit orchards are soon knee-deep in grass, and many of them are carpeted a brilliant yellow with wild mustard. As the buttercups come into bloom in late winter, wild bees emerge from their cells and pollinate them. Some migratory birds reappear as early as January and February on their way north again. Some ornamental fruit trees bloom in January, "pussies" appear on willows, and the first wild flowers bloom by February. Several species of manzanita and wild currant or gooseberry blossom in January. A few warm days at any time during the winter will bring out the Mourning Cloaks, and the early "spring" butterflies emerge in February.

RICHARD H. DILLON

WHERE THE DEER AN

COLONEL C. J. (BUFFALO) JONES, prototype for Zane Grey's *Last of the Plainsmen*, is hardly remembered today but in the period of the turn of the century he was hailed as "The Preserver of the Buffalo." He was more than that, however, and should, even now, bear the title "Creator of the Cattalo." Had he been more successful with his breeding experiments, who knows but Benny Bufano might have been commissioned by the government to execute a cattalo in profile on our nickel.

Colonel Jones, who was a close friend of Buffalo Bill Cody, tried to domesticate the American bison and succeeded in breaking two bulls (one a mankiller) to harness, but had little more real success than the first man to attempt to tame the unruly beasts, Don Vicente de Zaldívar. Zaldívar, one of Oñate's lieutenants in the conquest of New Mexico, tried to tame a few bison calves in 1598 but they "died of rage" within a few hours of being penned.

Jones decided to found a new breed by crossing buffalo bulls with domestic cows, and he was successful. While he found it difficult to raise cattalo (as he named them) bulls, he had great luck with cattalo cows. They were uniformly larger than their parents, averaging between 1,200-1,500 pounds, and not only bore splendid coats but were as good milkers as Jerseys. They were quieter than buffalo but cranky when handled. They made up for this bit of temperament, on the other hand, in hardiness. The cattalo could winter on the plains as far north as Canada in temperatures down to 50° below! All in all, they preserved more buffalo habits than cattle traits, one of the most noticeable being their preference for facing a blizzard rather than drifting south with the storm at their backs.

James McKay started a cattalo herd in Winnipeg in 1878, which Ernest Thompson Seton lauded, and California was not to be caught napping. An enterprising rancher named Winston caught a few buffalo, bought several more from Sitting Bull's Sioux, and stocked his one-hundred acre ranch near Pebble Beach with them. He crossed them with cattle in order to produce marketable robes—worth up to $280 each at the time—explaining, "the hair of the Gallo-

...ER AND THE CATTALO ROAM

way (cow) is extremely fine and the cross produces a superior robe, equal to sealskin." Newspapers of 1891 crowed that "Monterey County is to be the seat of a new California industry, in the shape of a buffalo ranch near the Carmel Mission." The buffalo robe and its kin, the cattalo robe, however, followed the beaver hat into oblivion. The Kansas, Manitoba, and California herds disappeared. Perhaps some of their progeny are running today with the protected herds of Wyoming, blissfully unaware of their exciting pedigree.

Sincerely Yours
C. J. Jones

Charles Jesse ("Buffalo") Jones. At left he is shown with two of his half buffalo heifers, the successful but short-careered cross, named "cattalo" or "catalo." (From *Buffalo Jones' Forty Years of Adventure*, compiled by Colonel Henry Inman, Crane and Company, publishers, Topeka, Kansas, 1889; through courtesy of Lee Lewis Burtis of San Francisco, whose copy was loaned to the Sutro Library).

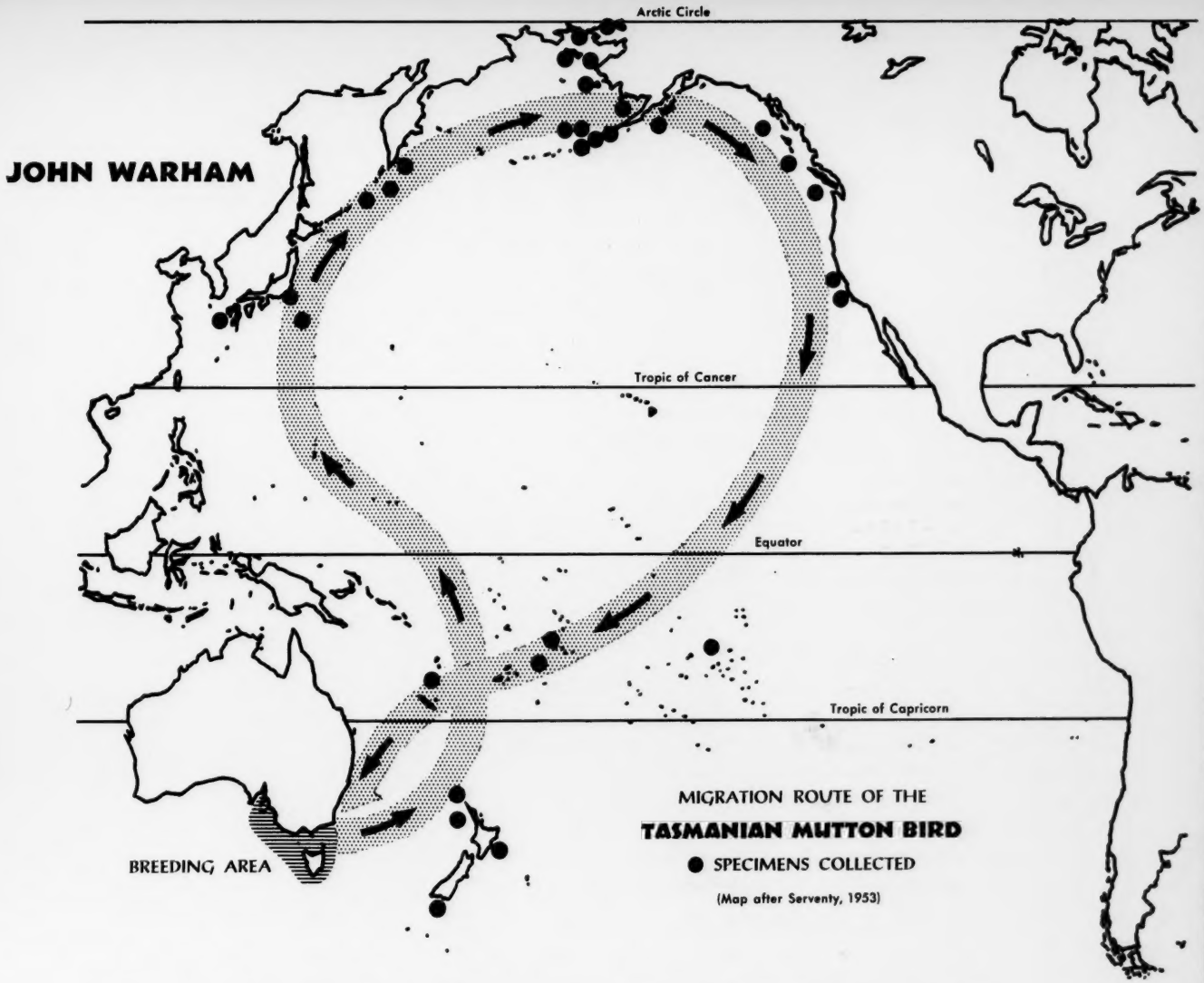
PACIFIC WANDERER

THE TASMANIAN MUTTON BIRD

TO FLY TWENTY THOUSAND MILES around the Pacific Ocean between breeding seasons is a remarkable performance for a bird no bigger than a crow. Yet this masterly feat of navigation and endurance is undertaken as normal routine by millions of Tasmanian mutton birds annually. And perhaps even more remarkable is that whatever the weather encountered, the birds make their landfall at the breeding islands in Bass Strait on the same date each year.

Formerly some people thought that these birds flew down into the Antarctic after nesting; others believed that they simply dispersed over the oceans. It is only recently that a neat piece of detection revealed the true nature of their post-nuptial wanderings. Their flight path on leaving southern Australia was first suggested by plotting on the map where Tasmanian mutton birds had been sighted or collected at sea. These plots indicated that on leaving their home waters in late April and early May, the main body of birds flies eastwards across the Tasman Sea and then swings north to the seas around Japan. Here mutton birds are abundant during May and June. Later the flocks swing right around the North Pacific and some even penetrate into the Arctic Ocean via Bering Strait. During August and September many are in Alaskan waters. The clockwise trend continues and the birds sweep southwards feeding off British Columbia, Oregon, and California. The final southerly leg of their journey home is poorly documented, but it is believed to carry them across the central Pacific and thence to the eastern Australian coast. Here dense flocks are seen flying south in October and early November. The general pattern that emerges is that of a figure-of-eight flight path as shown in the chart.

That this path is reasonably accurate is being confirmed by recoveries in the North Pacific—particularly around Japan and the Aleutians (where mutton birds are often caught in fishermen's nets)—of birds leg-banded at their Bass Strait rookeries. Thus a bird marked at Cat Island, a sanctuary in the Babel Group



where the accompanying photographs were taken, on March 30, 1958 was recovered, tangled in a Japanese salmon net, in the Aleutians on July 12 of the same year.

During their circulatory migration the birds have the benefit of following or near following winds and this perhaps accounts for the course they take. Only when they approach Australia again in the spring do they have to fight into the S.E. trades and it is significant that at this time many exhausted birds are washed ashore on Australian beaches. On examination most are found to be young birds, birds that have presumably lacked the experience to find sufficient food with which to maintain their energy reserves as they cross the trade belt to the safer waters farther south.

What kind of creatures are these which undertake such desperate wanderings across the open sea? Mutton birds belong to the genus *Puffinus,* whose members are commonly called shearwaters from their habit of flying at high speed hugging the waves so closely that, as one observer puts it, "you could hardly slip a dinner plate between them and the water." They have rather long hooked bills, plump bodies clothed in glossy brown feathers, short tails, and webbed feet. For food they depend on surface organisms like squids, small fish, and similar fare. Around the Aleutians flocks of a thousand birds have been seen feeding greedily on concentrations of minute Euphasid crustaceans.

In Australia and New Zealand several species have been called "mutton birds," but the Tasmanian mutton birds or slender-billed shearwater (*Puffinus tenuirostris*) is the most important of these: it is the only native Australian bird exploited commercially for food today. Something like half-a-million young ones are taken annually and after salting down in brine are sold in the shops of Tasmania and other places in southern Australia, and to a lesser extent in southeast Asia.

This harvesting of mutton birds has been going on for a long time. Captain Cook noted the presence of "sooty petrels" in the southern seas but it was Matthew

Flinders after his historic voyage around Australia who called the attention of the world to the seals and "petrels" of Bass Strait. This resulted in the many visits of American and European sealers to the area and mutton birds comprised an important part of their food. The Tasmanian aborigines, who had doubtless eaten the birds for centuries, probably introduced them to the sealers; and when white men came to live in "Van Diemens Land" these early settlers again took advantage of the birds as a source of food.

Because of this gastromonic interest the settlers paid a good deal of attention to the birds' behavior. They soon noted the remarkable regularity of their arrival on the islands and before very long the broader details of the mutton bird's economy were familiar to them.

To live among mutton birds during the nesting season as the writer and his wife did for five months is an experience not easily to be forgotten. By day all is quiet save for the thud of the sea against the rocks and the whine of the wind combing the deep tufted tussock grass clothing the islands. But at dusk a new sound arises, that of a high-pitched sighing from above as thousands of dark shapes swirl overhead into the teeth of the wind, their pinions slicing the air. Presently the birds drop lower, swinging past at high speed like outsize swifts as they skim over the grassy slopes. Their numbers are tremendous but collisions are miraculously infrequent. Soon they begin to drop to the ground. Checking their rapid flight with back-pedaling wings, they fall like black butterflies into the tussocks, pick themselves up, and scuttle down the dark pathways into the still darker entrances to their subterranean homes.

Up to this time the only sound has been the swish of their wings in the wind. But now their voices break out into a veritable devil's chorus of wails and groans as the newcomers serenade their mates and are greeted in turn. These weird songs continue on and off throughout the night, the wild cacophony ebbing and flowing over the rookery as the more ardent pairs stimulate their neighbors to join in the chorus. The din reaches a peak shortly before dawn when the off-duty birds start to make their way seawards, calling lustily as they go as if farewelling their husbands and wives underground.

Only since 1947 has organized research been undertaken on this species to determine the details of the mutton bird's economy in order that the take of young birds can be scientifically controlled without prejudice to the stock in future years. Today, as a result of these investigations, more is known of the habits of this particular shearwater than of any other member of its genus.

The work has been supported jointly by the Australian Commonwealth Scientific and Industrial Research Organization and the Tasmanian Animals and Birds Protection Board. It centers on tiny Fisher Island just off the Flinders Island port of Lady Barron from which the bulk of the mutton bird catch is shipped to market. Fisher Island carries a small discrete colony of mutton birds. Every member has been given a numbered monel metal band for identification and every burrow is marked with a numbered peg. Dr. D. L. Serventy, who is responsible for the station's work, now has a card index listing some 450 birds that have bred upon or visited the island. One has only to walk outside at night to pick up a bird and note its band number for Dr. Serventy to be able to give you its life history. He can tell you with which bird it is mated, if any, what divorces or remarriages it has had, how many young it has reared and, now that the study has gone on for over ten years, he can most likely say just when and in which burrow it was born!

In this way the personal biographies of many birds are being built up, a vast amount of detailed knowledge on the species is being collected, and facts have displaced conjecture. The general picture that emerges of the birds' activities on land is as follows:

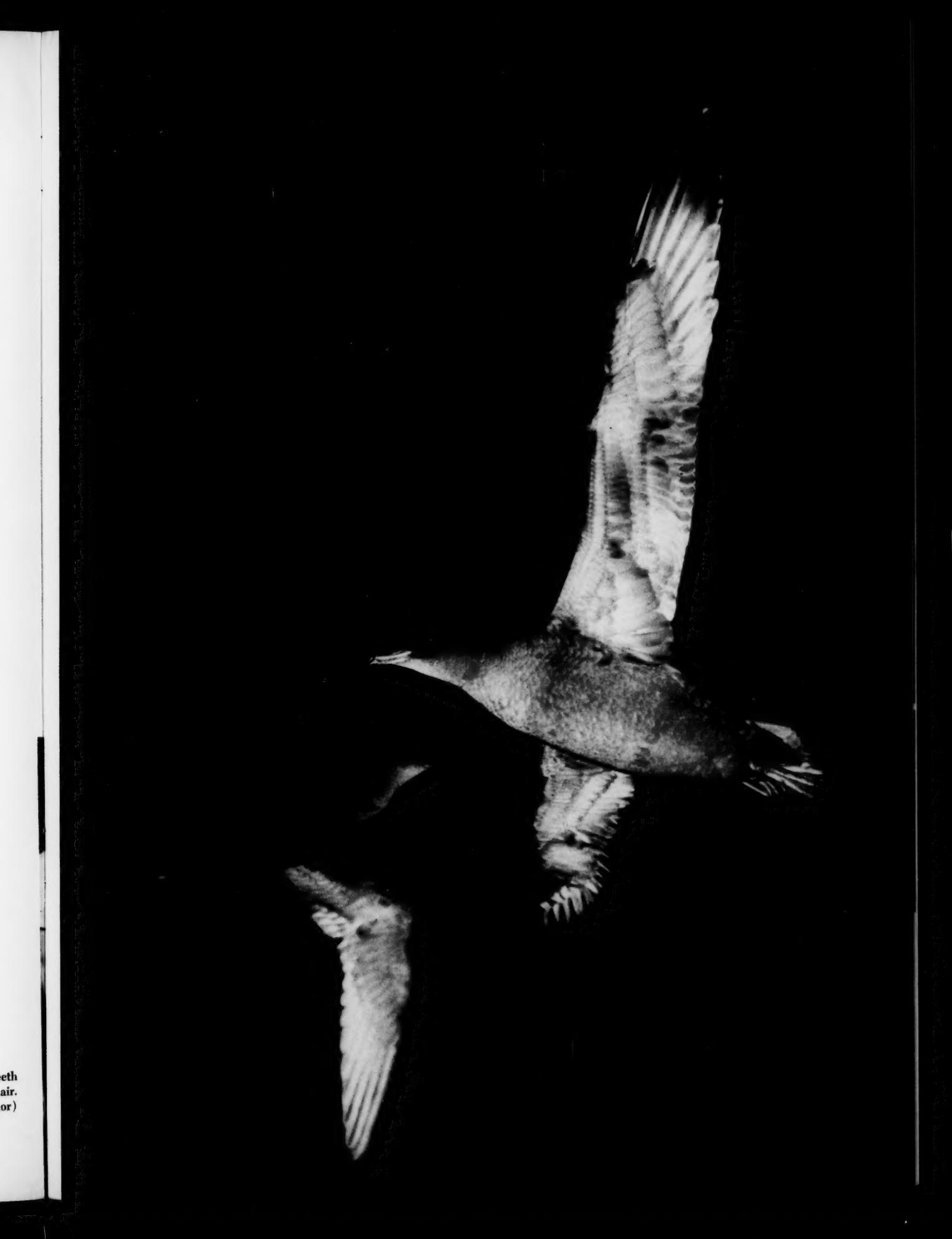
On their return to the islands in the last week in September the mature mutton birds have almost reached breeding condition and courtship and the cleaning out of burrows in the soft sand is soon in full swing. Spurts of dusty earth shoot up on all sides as the burrow cleaning progresses, the sand being raked backwards by powerful thrusts of the webbed feet. This activity is accompanied by much "singing."

Like many of their relatives, mutton birds shun the light once they are ashore and they make underground chambers at the end of a yard-long tunnel in which to rear their chicks. Courting birds utter eerie crowing cries as they nibble each others' heads with their beaks, renewing acquaintance with their partners after months at sea—for provided both have survived their oceanic wanderings mated birds usually remain faithful to one another each successive season. It seems this is not due to any natural mutual attraction, however, but to their marvelous homing ability which guides them back to the same burrow year after year. There they meet once again and renew their association for the season.

In the midst of this feverish nocturnal activity a dramatic change occurs: the birds abruptly desert the breeding grounds. This takes place at the beginning of November and for about 18 nights the islands remain strangely muted and peaceful. Then one night the birds reappear after dark as abruptly as they left. Pick up one of the newly arrived females as it rests on the ground, getting its bearings before scuttling off to its burrow, and the huge egg can be plainly felt through its body. During their abrupt exodus the females' eggs have developed and laying begins immediately on their return to the islands.

The eggs appear between November 20 and 30 each

Dark shapes swirl overhead into the teeth of the wind, their pinions slicing the air. (All photos by the author)



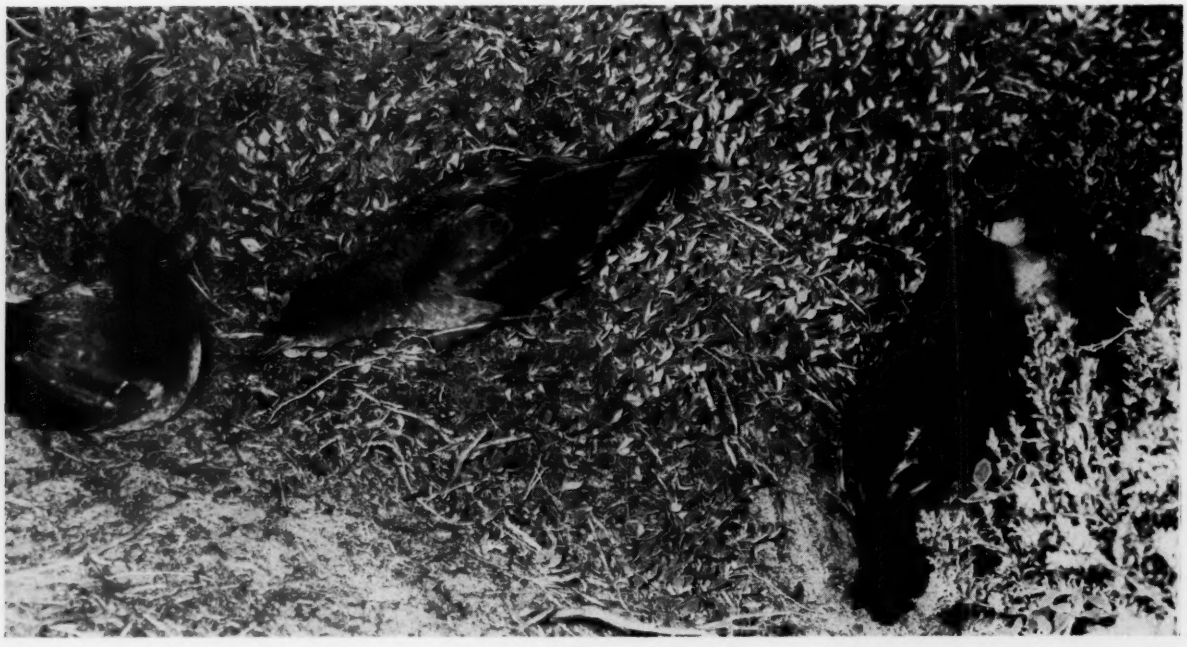
year and the period does not vary with the weather nor from rookery to rookery despite the fact that some 800 miles separate the most westerly breeding islands from the easterly ones. Having done her duty by laying the egg the female now shuffles off to sea leaving her mate to take the first span of incubation, for sexual equality is the rule in the mutton bird world. The male sits patiently underground in the dark burrow day and night without food for about a fortnight or until his wife reappears once more and relieves him for a further 14 days or so. This turn and turn about routine continues until the egg hatches after about 53 days. The female is generally on duty during this event and she or her mate remains for a further two or three days with the newborn chick.

At this tender age the young bird, its eyes closed and its dusky down covering its body from head to tail so that it looks like a soft gray powder puff, is left unguarded by day. But during its first week of life it is attended by one or both parents at night and receives generous fishy meals which are regurgitated into the little one's bill. These feedings soon become less frequent and subsequently the nestling gets a meal only about once a week. Now, although both parents still feed, they generally come ashore on different nights and probably many do not see each other thenceforth until they are reunited at the burrow the following year.

Infrequent though they are, the meals are substantial and very nutritious. The chick is soon fat and by early March it weighs as much as an adult although few feathers have yet begun to show. Meals now tend to become smaller and they cease altogether in April. The nestling is deserted. This occurs well before the chick can fly, but during the desertion period it loses weight rapidly, the feathers sprout, and presently the bird begins to emerge from its burrow every night to exercise its wings. Eventually, at about 94 days old, and a fortnight or so after desertion the chick works its way under cover of darkness down through the tussock to the shore. Eventually it swims out to sea without parental assistance. By this time the old birds have probably left the vicinity of the islands and are well on their northward migration. The chicks that survive their initiation to the sea follow as soon as their wings will carry them.

Like other shearwaters and petrels, the Tasmanian mutton bird lays only one egg. If this is destroyed the female cannot lay again that year. So, at first sight, it is rather surprising that the species should be so plentiful as to quality for the title of Australia's most abundant bird. Banding has explained the apparent paradox. Once they have withstood their first trial years at sea the birds are likely to enjoy a long span of life. Indeed, females do not lay fertile eggs until they are five years old while the males take even longer to reach maturity: they breed from seven years onwards. Their longevity and repeated opportunities of rearing young thus make up for the small clutch size.

What do the birds do through all these years of im-



↑ Courting birds utter eerie crowing cries as they nibble each other's heads with their beaks, renewing acquaintances with their partners after months at sea.

➔ During its first week of life the young bird is attended by one or both parents at night, getting generous fishy meals regurgitated into its bill.

maturity? The story of the two-year-olds is not yet unraveled. We know that fledglings make the northward migration and that this is done rapidly—for one chick had covered the 5,500-mile journey from Tasmania to Japan in a month—but we do not yet know where the second year is spent. But from three years of age onwards some immatures start turning up on the islands where they were born. Thus the thousands of mated and mature breeders are swollen by great numbers of immature birds. These look just like the mature ones and many soon acquire mates, may even excavate burrows and generally go through the motions of breeding without producing viable eggs. Someone called these birds "sweethearting couples" and the expression gives a very good idea of their status in the colony.

Sweethearting birds do not spend as long on the rookeries as the established pairs. The latter are the first to return at the end of the migratory period and thus make certain that immature birds do not steal their burrows. Of the immatures, many of five years or older return with the breeding pairs after the abrupt exodus early in November but the three- and four-year-olds seldom appear on land until January. By this time, of course, the breeders are beginning to hatch their young. Again, all the immature birds tend to disappear from the islands well before the chicks are deserted, so that as the season progresses the activity ashore—and the noise—decreases. By the end of March the nights are relatively quiet and the only birds coming in at dusk are those with chicks to feed.

One of several unsolved problems is how the mutton birds succeed in finding their own nests. The tussock-clad slopes of the islands look so uniform that it would seem impossible for any individual bird to pick out a particular nest from among thousands of others similarly placed. Yet follow a bird as it weaves about in the dusk between thousands of its fellows and you may see how it circles the same part of the rookery several times before finally alighting and, often without any hesitation, popping into its burrow. The present writer

believes that this ability is due simply to an acute sense of location, a sense that is a good deal keener than our own. Also, we should bear in mind that during their many seasons as sweethearting birds they must become very familiar with the configuration of the ground around them—they stick to one part of the colony even before they get a burrow of their own—so that they may well come to know that part of the island "like the back of their hand." Thus, only a few preliminary circlings in the half light and they are orientated for a landing right by their homes.

When the mutton birds do alight the switch from their aerial mastery to earthborne clumsiness is almost painful to see. Their legs are set so far back on their bodies that they tend to topple forward and must waddle along in a duck-like posture to gain their burrows. Getting aloft after the night's activities may also be difficult if the morning is windless. At such times the birds scramble up any convenient hillock to gain extra height for the take-off. Selected rocks become the focal points for a crazy and frenzied concourse of birds anxious to reach the safety of the sea before the first touch of dawn lights the eastern horizon. The scene has all the flurry and bustle of a bargain basement at sale time.

Any injured bird that fails to reach the water by daylight will probably be killed by the big Pacific gulls that inhabit most of the mutton bird islands. These also manage to eat many of the eggs and chicks and their presence is presumably why the shearwaters are reluctant to land in daylight. But since the old birds return to their nests only at 10- to 14-day intervals and probably travel hundreds of miles on their food gathering trips, they may get back to the vicinity of the islands well before dark. When this happens they hang about a few miles offshore until evening and on calm days huge rafts of mutton birds can be seen resting, preening and flying around, forming long brown smears on the water, until nightfall brings them home once more.

↑ Painfully awkward on land, these superb fliers scramble up any convenient hillock to gain height for their take-off on a windless morning. The scene has all the flurry and bustle of a bargain basement at sale time.

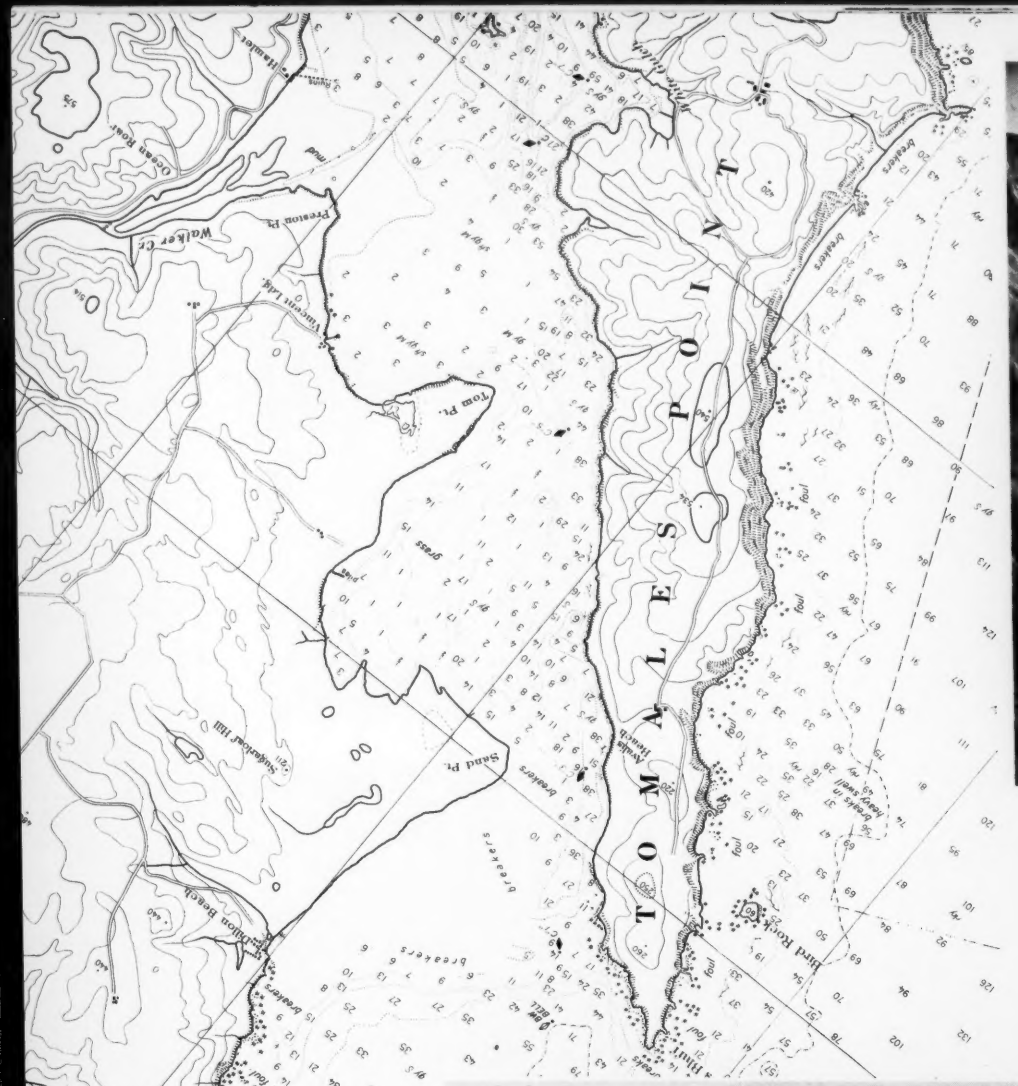
Apart from the gulls the birds have comparatively few enemies on land. Small chicks and eggs are eaten by skinks and by the very venomous tiger snakes that usually abound on Bass Strait islands. Neither attacks well grown chicks or adult birds. Once the young have left the island their first year at sea seems to be the critical period, for lacking experience they have to find their own food, to learn how to make use of contrary winds, and to ride out the storms. That a large proportion of first year birds do succumb is certain and this is one reason why human predation on the well grown young has had little effect on the bird's total numbers. Many of the squabs taken for food would, in fact, perish during their first year at sea.

Mutton birding is now quite different from the free-for-all that obtained in the early days. Only well grown squabs are taken—no adults, and then only under license. The chicks are withdrawn head first from the burrows, their necks broken with an expert flick of the wrist and each is then spitted through the beak onto a pointed stick. About 50 birds are carried at a time from the rookeries down to processing sheds set up on the various commercial bird islands. Here the first operation is to squeeze out the red stomach oil. This is used in sun-tan lotions and medicinally. The birds then pass to pluckers who remove most of the down and store it in sacks. It is due to the fine heat retaining properties of the down that the tiny chick can be left uncovered by day without harm. The weather is often cold and wet on the islands but the chick is never brooded even when the parents come to feed it. The downy coat is its main protection from the weather. It is not surprising, therefore, that the down is in great demand after cleaning and deodorizing for lining sleeping bags and it fetches a good price. Finally, the completely plucked birds are cut open, cleaned and washed, and packed carefully in brine, about 200 birds to a barrel. Some are packaged in plastic containers for marketing overseas.

The industry is at present being reorganized but something like 400,000 birds were taken in 1957, worth some $70,000, and the industry is still the mainstay of the unique Cape Barren Islanders, the descendants of the now extinct Tasmanian aborigines and the early British and American sealers.

The history of this recent research on the mutton bird provides a fine example of what can be achieved on a single bird species. But much is still unknown. We are largely in the dark about the movements of the various age groups. Do all of them circulate around the North Pacific or only birds of certain age classes? Tasmanian mutton birds are most numerous off California in December and these must presumably be immatures for the adults are breeding then. But perhaps the biggest riddle of all is why this bird should undertake such a journey at all, for its home waters are by no means devoid of food in the southern winter. Indeed, many birds closely related manage to earn a living in the area without migrating—they simply disperse after breeding and find their food in home waters. Which seems a more sensible arrangement than to go trailing all around the ocean in between nesting seasons. . . . Yet there must be some reason: perhaps one day we shall discover it.

The mutton birds' chief enemies are man—the market hunter—and a venomous tiger snake and a skink that eat eggs and young chicks.



Bodega Head, about fifty miles northwest of the Golden Gate, is a scenically striking and scientifically interesting feature of the California coast. The air views (BELOW and COVER) clearly show its relationship to Tomales Bay as continuing the great rift of the San Andreas Fault (taken by William A. Garnett with the editor, on a clear spring day). Highest elevation on the Head is 239 feet. (ABOVE) Rugged seascape of Mussel Point, north end of the Head; (BELOW) Horseshoe Cove, the deep seaward indentation of the Head (taken by the editor). The chart is part of C.&G.S. 5603, "Bodega and Tomales Bays" (reduced one-third). North is to the lower left.


Science at the Seashore

Science at the Seashore

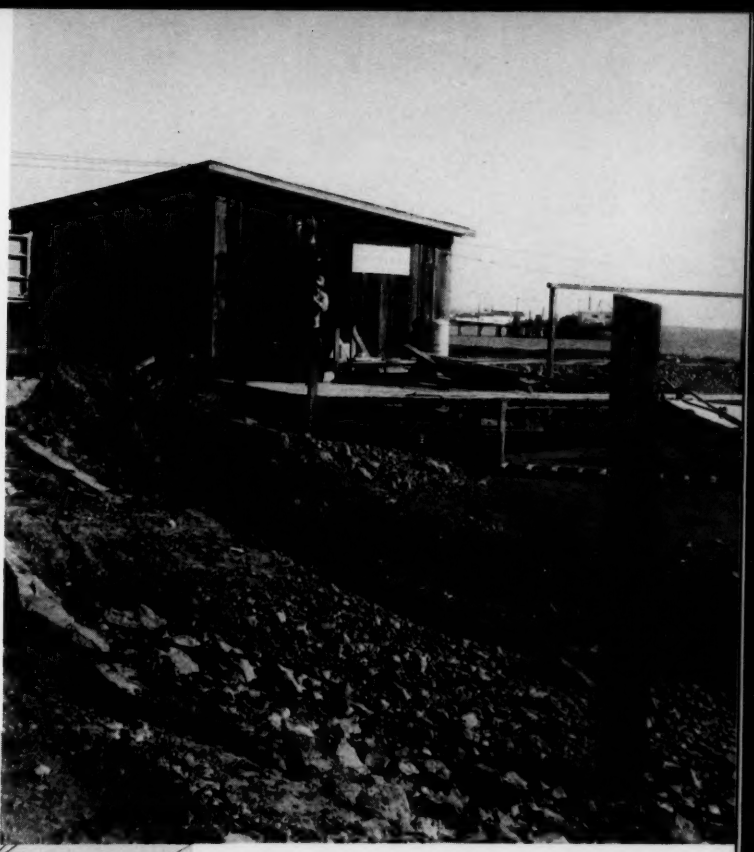
OF THE MANY USES of the sea shore the most demanding is that of science, in the form of marine laboratories devoted to fundamental research, to fisheries research, or to teaching. Because of the great variety of plant and animal life on the sea shore (exceeding in range of basic forms that on land or in fresh water), many academic institutions require study at the sea shore for advanced standing in biological science, and for a hundred years now marine laboratories have been built and maintained by universities and governments all over the world. In many instances such laboratories have been part of or are closely associated with reserved areas, to protect shore life from unnecessary devastation and interruption of research programs. As we turn more and more to the sea for resources the importance of such laboratories will increase and their contributions to general knowledge will become more significant.

The marine station idea is now over a hundred years old, and the oldest permanent marine station, at Concarneau, France, celebrated its centenary in 1958. In America, the oldest station is the Marine Biological Laboratory at Woods Hole, founded in 1888. The "M.B.L.," a lineal descendant of Louis Agassiz's summer seashore laboratory at Penikese, has been a major influence in American biology and is a mecca for hundreds of visiting investigators. Indeed, so many people want to work at Woods Hole every summer that there is no longer room enough for them all and we may have, in the not too distant future, a "Woods Hole of the West" somewhere on the Pacific coast. Whether this materializes or not, the growing population of our colleges is increasing the need of adequate "outlets to the sea." Yet good sites for marine laboratories are scarce on the Pacific Coast, and promise to become scarcer. One fine site, at Morro Bay, has been lost, and the finest of all, Bodega Head, is in danger.

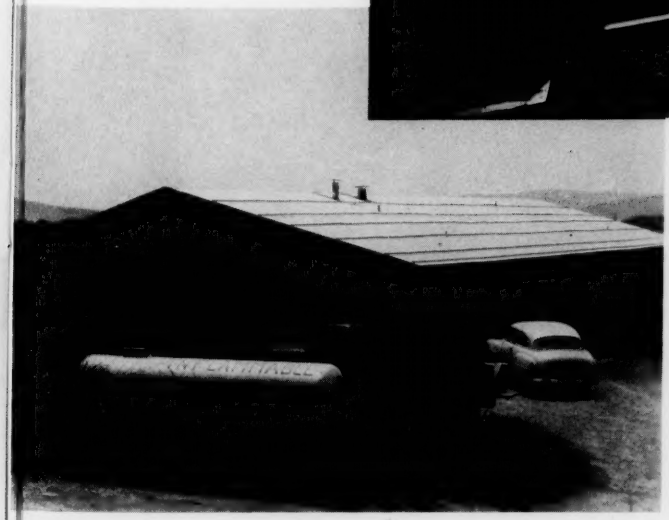
There are at the present time seven year-round founded at Dillon Beach in 1947 but did not open for year-round activity until 1957. Hopkins Marine Sta-

JOEL W. HEDGPETH

The question:
How to use the seashore?
The controversy:
Scientific study plus
recreation for all—
or power development?
Coming test case:
Bodega Head

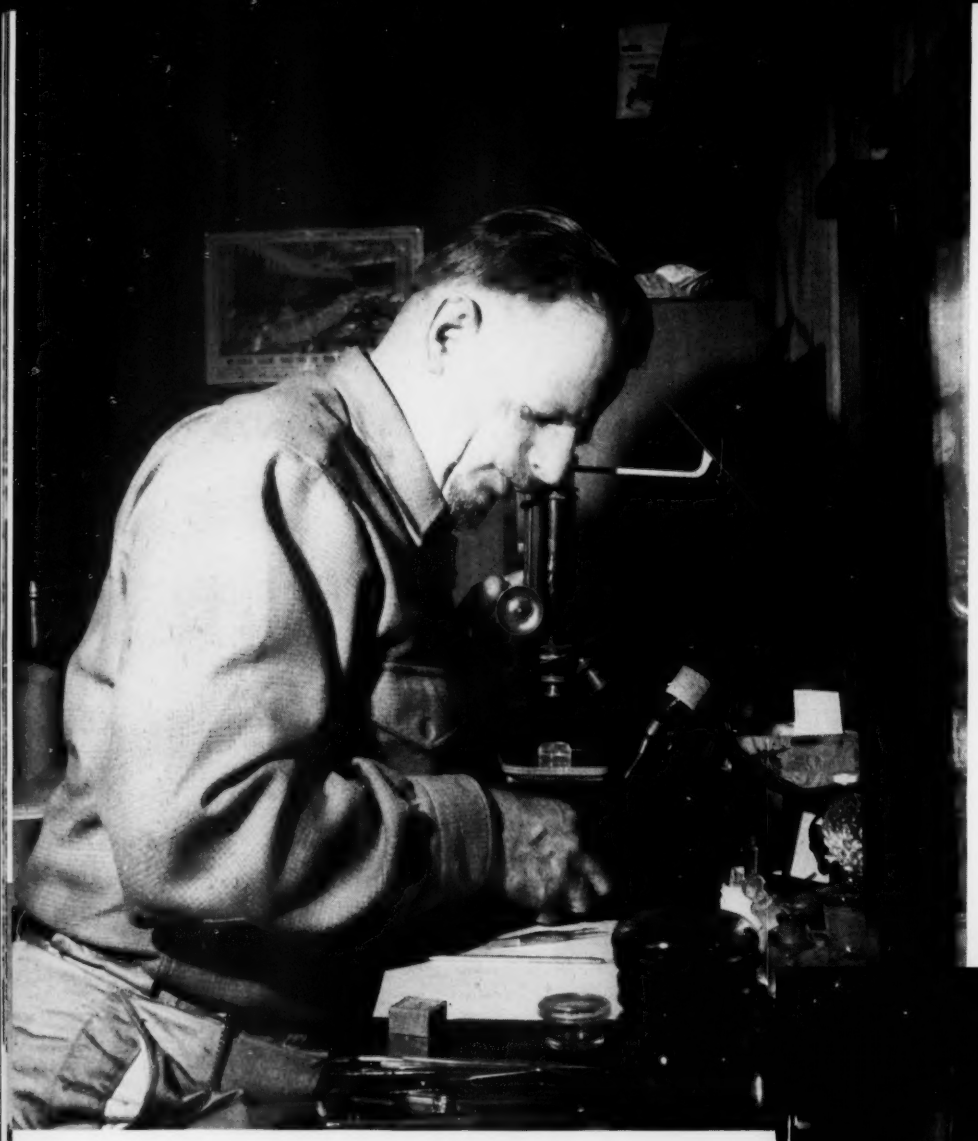


Although the University of California has a seaside campus at Santa Barbara and another at La Jolla—Scripps Institution of Oceanography, it badly needs a marine research facility near the Berkeley campus. This shack at Bodega Bay (ABOVE) has on occasion been forced to serve that need—how inadequately can easily be imagined (photo by the editor).



Marine biological stations on the Pacific Coast are not, by accepted standards, luxurious. Their staffs and students conduct research of great present and potential value to all humanity, often with barely adequate facilities. The University of Washington's Friday Harbor Laboratories, San Juan Island, Puget Sound, comprise modest buildings, docks, and vessels, maintain highest teaching standards (photo by Whitie Marten, State of Washington Campus Studios, OPPOSITE PAGE).

Pacific Marine Station of the College of the Pacific operates at Dillon Beach, Marin County, California, in two large sheds and a motor launch, under the directorship of the author (photos: LEFT, PMS files; CENTER PAGE, editor).



← The author, *PD* Associate Editor and Director of the Pacific Marine Station, Dr. Joel W. Hedgpeth, claims this microscope in his own laboratory to be "probably at least as good as the one Charles Darwin used, but no better."

↓ Dr. Hedgpeth shows a visitor, Nancy Gapinski, a fine slab of fossil crinoids in the wood slab-sided museum room of the Pacific Marine Station. Each day should begin here with a prayer: "Let there be no fire."

marine stations along the Pacific Coast, from Nanaimo, British Columbia, to La Jolla, California. Of these, the station at Nanaimo is devoted primarily to fisheries research and is maintained by the Fisheries Research Board of Canada; and the Scripps Institution of Oceanography of the University of California is the world's largest oceanographic laboratory, with a comparatively small percentage of its multitudinous activities directed toward work along the immediate shore. The other stations rely for the most part on the natural resources of the environs for the field of study and supply of organisms for laboratory use. Friday Harbor, the station maintained by the University of Washington, is located on San Juan Island in Puget Sound, and its isolation has inhibited its growth for many years, although there are now plans for expanded year-round operation. Pacific Marine Station, a branch of the College of the Pacific, was

tion at Pacific Grove is the oldest marine station on the Pacific Coast. It was started by Stanford University in 1892, the second year of the University's life, and has been in continuous operation since. One of the newest marine stations is that on the campus of the University of California at Santa Barbara (at Goleta), which is a small installation that has the great advantage of being directly on the campus and is actually part of the natural sciences department. The California Institute of Technology operates the Kerckhoff Marine Biological Laboratory at Corona del Mar, near Newport Bay.

In addition to these permanent stations there are several field stations, operated during the summer, of which the most important is the Oregon Institute of Marine Biology at Charleston at the mouth of Coos Bay. There is also the Allan Hancock Foundation of the University of Southern California, which operates a seagoing vessel and maintains a large research museum devoted primarily to marine organisms. The expanding program of colleges and universities on the Pacific Coast has emphasized the need for greater utilization of all these existing facilities (several of them have substantial summer National Science Foundation Institutes), and in at least two instances, for new laboratories. The expansion of the wildlife curriculum of Humboldt State College and its remoteness from major metropolitan centers have resulted in plans for a major laboratory plant near Trinidad Head, a few miles north of the campus. The University of California at Berkeley, parent campus of the educational colossus, is in critical need of facilities for its own graduate program that cannot be met at Scripps or Santa Barbara, and members of the departments of zoölogy and botany have been looking for a good laboratory site. During the summers of 1956 and 1957 field courses were given at Bodega Bay, and the unique advantages of Bodega Head as a laboratory site prompted those concerned to recommend it to the University administration. Unfortunately the site also seems ideal, from the engineering standpoint, for a power plant, and is now under condemnation proceedings for that purpose.

Yet Bodega Head is by all odds the best remaining site for a marine laboratory, when the various factors of accessibility, freedom from pollution of the water, nearness to a commercial fishing port, and varied types of shore environments (rocky shore, sand and sheltered mud of an embayment) are taken into consideration. There may be sites that provide excellent rocky shores, or broad reaches of sand, but no other site provides so many different types of environment, with as rich a variety of marine life, and still remains within reasonable distance of centers of learning, as Bodega Head. Since these things cannot be moved, a biologist naturally wonders whether the engineers might not think a little harder about other sites for a power plant.

Mankind's future will be one of increasing dependence on the resources of the sea, and the importance of science at the seashore will increase correspondingly. The loss of Bodega Head to commercial or industrial interests would be a tragedy for the development of biological science on the Pacific Coast.

Fine buildings, modern microscopes, sound vessels—all would be of little use if there were no life-giving seashore left to learn from, no lonely headlands for contemplation, nor teeming tidepools under the surf.

(Photos by the editor)

Annette Richards Parent

Hal Gras, manager of the Desert Ark, with some of his wild animal charges. (Harry Zabower, *Tucson Daily Citizen*)

WHILE three quarters of a million people have visited the living Arizona-Sonora Desert Museum outside of Tucson in its first five years, some 80,000 youngsters of all ages have had some of the wild animals brought right to them in school, church, and service club. The desert animals are transported safely all over Arizona in an air-conditioned forest-green and white 1956 station wagon which has clocked some 25,000 miles as the "Desert Ark," the Junior Museum Project. Ring-tailed cats, badgers, skunks, mountain lions, gophers, prairie dogs, hawks, snakes, raccoons, and kangaroo rats teach audiences to lose unreasoning fear of wild creatures and to gain intelligent respect for them through learning something about them.

Hal Gras, public relations director of the Desert Museum, preaches with a sense of humor, comparing human with animal behavior. The handicapped are encouraged to exercise injured body parts because Cricket the Harris Ground Squirrel regained 100 per cent use of a badly mangled leg through persistence. La Vaga the Ring-Tailed Cat fights discrimination by permitting anyone to pat her whether his eyes are green, purple or pink—and demonstrates that she is friendly because she has never been hurt or teased. Rooney the Kangaroo Rat crusades against thoughtless name-calling because he himself is neither a kangaroo nor a rat. Although B-B the Badger is bowlegged, knock-kneed, and pidgeontoed, she is still pretty because she is happy.

In forty-five minutes, six or seven animals taken one by one from their green carrying cases give the audience an intriguing time that is both instructive and entertaining.

↑ There is never a lack of eager young volunteers to help carry the animals in their cases from the Desert Ark to the place where the program is to be held. (Jack Sheaffer)

← Given a choice at the end of the program, children can touch La Vaga the Ring-Tailed Cat or Charley the Gopher Snake. These fascinated youngsters choose Charley. (Jack Sheaffer)

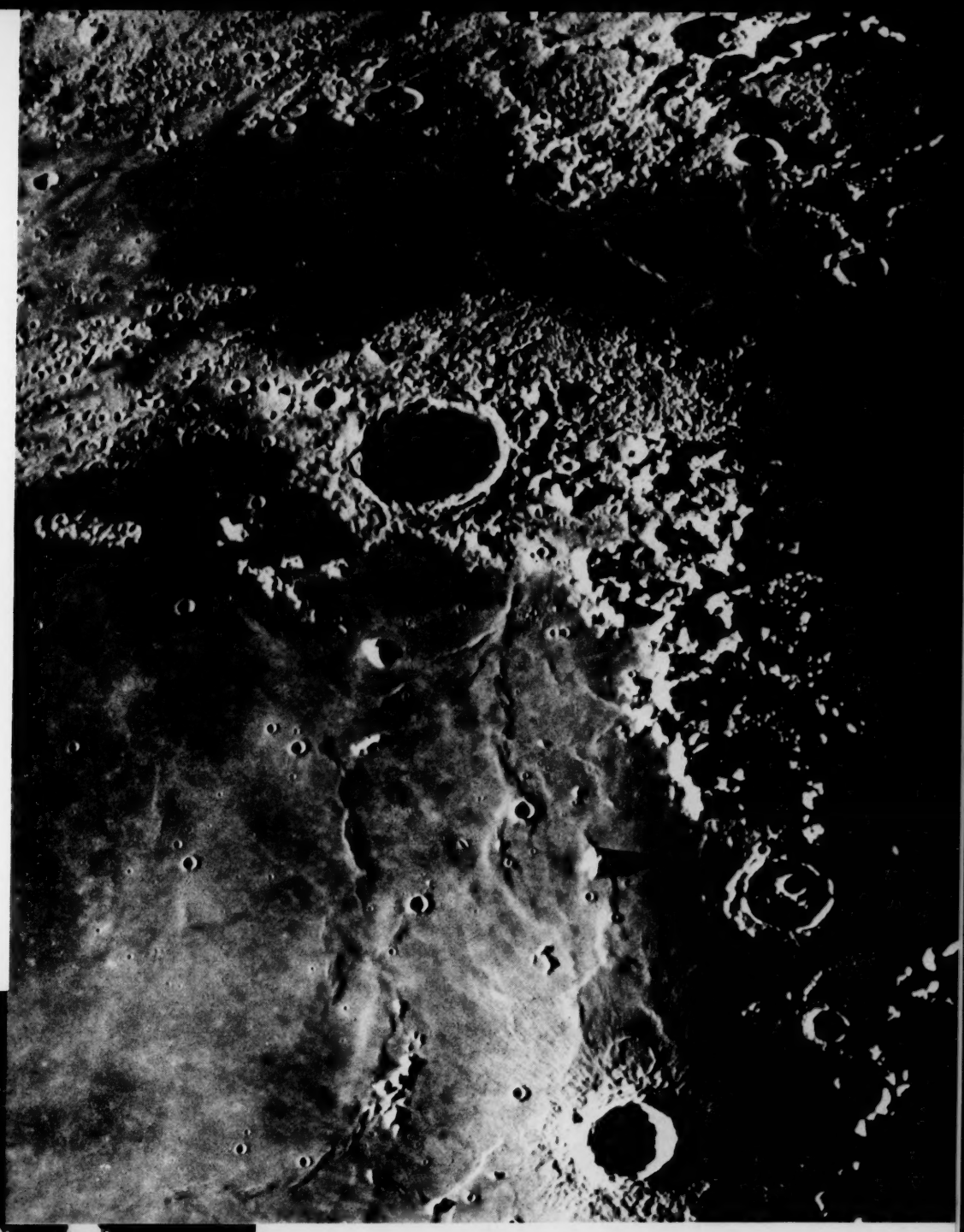
The Mountains of the Moon

ON THE SHELVES OF THE LIBRARY of the California Academy of Sciences stand several volumes devoted to the surface features of the moon—treatises by experts such as Baldwin, Serviss, and Alter. The bulk of their text is devoted to descriptive material on the craters, walled plains, and maria. The writers give considerable space to discussion of the possible origin of these features, and each author has his own ideas on the matter. All admit, however, that final decisions as to origins must wait for more direct scrutiny by geological experts transported to the moon for exploration. Certainly the craters will be the principal objects of scientific study when man is first placed on the moon. When lay visitors begin taking excursions to the moon, they will likely find the giant craters and walled plains that appear so prominent from the earth to be greatly disappointing upon examination from the moon's surface. One could stand at the center of many of the larger craters and not be able to see the mountainous rim even as close as thirty miles away. This is due to the fact that the curvature of the moon's surface is much greater than that of the earth, and the horizon is correspondingly closer on the moon.

The features that will appeal most to the sight-seer are the lofty and precipitous mountains of the moon that outshine any of the earthly ranges in sheer apparent height and rugged grandeur. While none of the mountains on the earthward side of the moon quite measure up to the height of Mt. Everest, some of the peaks in the Liebnitz and Doerfel ranges near the south pole of the moon come near equaling it and would *seem* higher because one could view them from a much lower level. The great ranges of the moon appear to be of uplift origin, like the Sierra Nevada range in California. The Apennines, a lengthy range on the moon named after a range on the earth, shows a gentle though rugged slope on one side, and a very steep escarpment on the other. This suggests a wedge-like uplift rather than folding as its origin. Peaks in this range stand eighteen to twenty thousand feet above the great plain of the "Sea of Rains" to the east. The Leibnitz mountains at the south pole of the moon form a jagged edge to the lunar disc at that location when seen through a telescope. There are peaks here that stand 26,000 feet or more above the plains of the moon. Who knows but that the first explorers to the moon will find even higher ranges on the side that is perpetually turned away from the earth?

Mountain escarpments on the moon are far more lofty and spectacular than can be found on the earth. This results partly from the fact that gravitational force at the surface of the moon is only one-sixth of that at the earth's surface, and rocky slopes can stand at a much steeper angle without being dragged down by their own weight. Furthermore, in the absence of water and air on the moon, the erosive forces so prevalent on earth are absent and have never existed. While glacial erosion has produced the beautiful matterhorns in earthly mountain ranges, these are only temporary and they are eventually worn down to the rounded forms so common in the older ranges on the earth. The peaks on the moon have suffered only the most superficial erosion under the alternate heat and cold of the lunar day and night. They stand frozen as fossils of the violent formative period of the moon's youth.

One should be careful not to overemphasize the quiet that prevails in the crustal surface of the moon, for amateur observers of the moon have often reported misty changes in some of the finer features. Recently,



↑ The crater Plato may be seen, slightly foreshortened, toward the top of the photograph. It lies in the midst of an extensive mountain range called the Alps. Immediately below Plato, in the midst of the plain called the "Sea of Rains," stands Pico. Piton is in the lower center. (Photograph courtesy Lick Observatory)

← Peaks in the Leibnitz range catching the oblique rays of the sun, as visualized by David Porrazzo, Alexander F. Morrison Planetarium staff artist.

SKY DIARY

March, April, 1959

(Pacific STANDARD TIME used throughout)

Phases of the Moon

Last Quarter	March	1	6:54 P.M.
New Moon		9	2:51 A.M.
First Quarter		17	7:10 A.M.
Full Moon		24	12:02 P.M.
Last Quarter		31	3:06 A.M.
New Moon	April	7	7:29 P.M.
First Quarter		15	11:32 P.M.
Full Moon		22	9:13 P.M.
Last Quarter		29	12:38 P.M.

The Planets

Mercury: Reaches greatest eastern elongation on March 12 when it will be favorably placed for observation for about a week around this date. Look above the western horizon between 6:30 P.M. and 7:15 P.M. It will be below Venus and about 1/20 as bright. Reaches inferior conjunction on March 29. Becomes a morning star in April when it reaches greatest eastern elongation on the 26th, although this is not a very favorable elongation to observe.

Venus: A brilliant evening star (mag. —3.4) visible above the western horizon and setting about 2½ hours after sunset.

Earth: Spring begins on March 21 at 12:55 A.M.

Mars: During March is in Taurus (mag. +1.1) setting about midnight. During April moves into Gemini and fades to magnitude +1.5.

Jupiter: During March in Scorpius (mag. —1.8) rising about midnight. It begins its retrograde motion on March 18. By mid-April it has increased in brightness to magnitude —2.0 and dominates the southern sky from 10 P.M. to sunrise.

Saturn: In Sagittarius (mag. +0.8) rising about two hours after midnight by March 15. Reaches western quadrature (90° west of the sun) on March 27. By mid-April it is rising about midnight. On April 16 it begins its retrograde motion.

C.F.H.

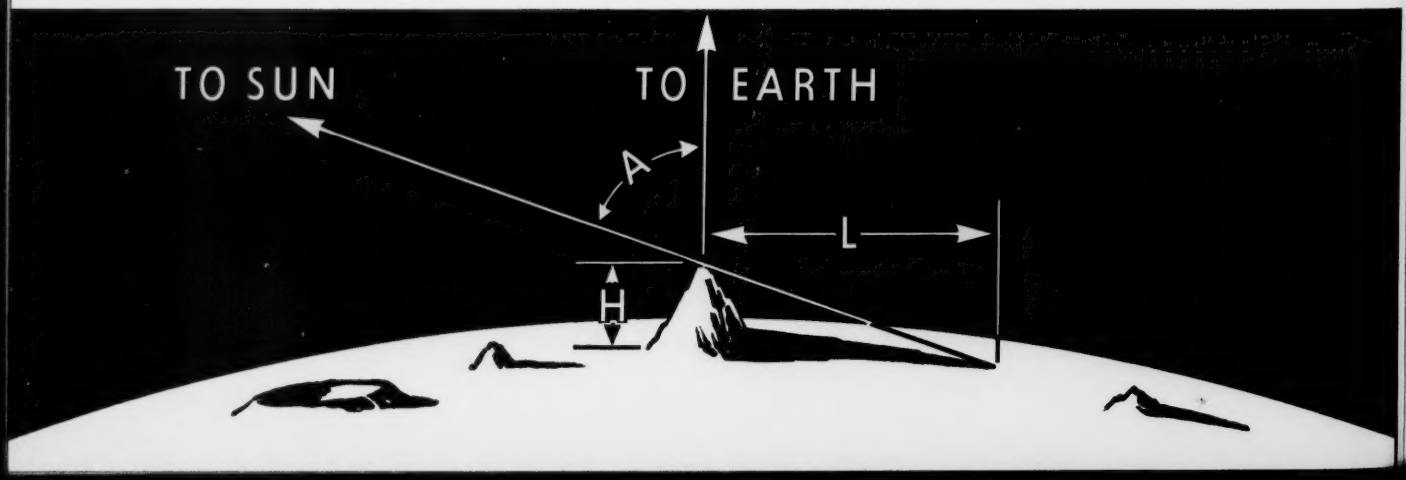
Dr. Dinsmore Alter reported that comparisons of infra-red and blue photographs of certain areas of the moon, notably within the crater Alphonsus, showed differences that could be accounted for by the presence of seepage of gases from the crust of the moon. This was dramatically verified by the spectroscopic observations of Nikolai Kozyrev in Russia, which caught some sort of "eruption" in progress in the same area. The spectrograms show what must be interpreted as the temporary presence of gas. We are forced to admit that the moon is not quite dead.

Some of Alter's photographs, made with the 60-inch reflector at Mt. Wilson Observatory, show low, gently sloping peaks with tiny craters at the very top. These have the appearance of volcanic craters of the type we know on the earth. In contrast to these there are isolated sharply peaked mountains—single, steep-sided peaks—standing alone in the midst of some of the great plains of the moon. Two of these, Piton and Pico, are within a hundred miles of one another in the "Sea of Rains." Piton is 7,000 feet elevation and Pico is 8,000 feet. These must appear as magnificent monoliths if they could be viewed from the surface of the lunar plain. There is some uncertainty in their heights, for the methods that are used to measure the heights of the mountains and the depths of the craters depend upon the measurement of very small angles as seen through the telescope.

One method requires the measurement of the length of the shadow cast across the plain by the peak. From this datum and the "geographic" position of the peak, plus the position of the sun, the height can be determined, limited only to the accuracy of the measurement of the shadow. The other method depends upon the determination of the exact instant that the first rays of the rising sun strike the peak. It appears as a star shining in the dark part of the moon. A measurement is then made of the distance from the terminator (the line dividing the light from the dark on the moon's surface), and from the curvature of the moon it is then possible to obtain a close approximation to the elevation of the peak.

When man reaches the moon, he will marvel at the ruggedness of the lunar world. He will find the moon to be a far more mountainous land than the earth, but there will be no forest cover to give the lower slopes the familiar dark green mantle, and no snow-capped peaks will decorate the horizon. The moon is a barren and rocky world, but its scenery is almost as old as the moon itself.

G.W.B.



The height (H) of a lunar peak is determined from the length (L) of the shadow and the position of the sun with respect to the direction of the earth, the angle (A). A further correction must be made to allow for the fact that a vertical line through the peak does not necessarily point toward the earth.

MAP OF THE MOON. Some of the features mentioned in the text can be found here: The Apennines are a little above center. Piton is to the left or east of center about half-way btween the Apennines and the Sea of Cold near the North Pole. Pico is farther east and north, directly below Plato. The Leibnitz range is at the extreme bottom center, and the Doerfel ranges are a little to the east. (The Planetarium book counter sells this map at five cents a copy.)

DISCOVERY IN BOOKS

Wilderness rediscovered

Nature and the American: *Three Centuries of Changing Attitudes.* By Hans Huth. University of California Press, Berkeley and Los Angeles. 1957. xvii + 250 pp., 64 halftone plates, frontispiece in full color, 29 line cuts. $7.50.

The occasion of the Sixth Biennial Wilderness Conference being held in San Francisco just after this issue comes off the press invites reflection upon various aspects of the wilderness idea—one of them, its history. Every history has its much longer prehistoric period, and this is true of the concept of wilderness which conservationist thinkers have brought forth only within the last generation. In Hans Huth's *Nature and the American,* the "three centuries of changing attitudes" toward nature in our country might be considered the prehistoric period leading up to the little "more than a quarter century [which] has passed since the beginning of the wilderness movement." And in fact the chapters in the book fall in about that proportion.

We have progressed in three centuries from an almost universal Western or European cultural attitude—transplanted to the "new" continent—of wilderness as "howling," "horrid," "fearful," to be shunned altogether where it could not be brought under ax and plow: from this we have come to the philosophy that, where we have some wilderness left from or beyond reach of ax and plow, not only is it inherently beautiful and enjoyable but as much of it as possible *must* be preserved for the *good* of humanity. The how of this progression is of course the historical process the author examines in considerable detail.

As the new attitude filters down through the pyramid of popular awareness to reach an ever broadening base of public acceptance, it becomes perhaps increasingly difficult to imagine the old one we started with—that there was a time when, in 1679 "Father Hennepin, the first man to report about Niagara Falls," could write of "a horrible precipice" at whose foot the waters "do foam and boyl after the most hideous manner imaginable, making an outrageous Noise, more terrible than that of Thunder," and that "dismal roaring may be heard" from way off. But the change from this attitude to ours Mr. Huth has found clearly documented in books and other print and in pictorial art, in letters and diaries, even in the advertisements of the railroads, resorts, and other caterers to a public progressively more and more travel- and vacation-minded during the last of his three centuries. It's in the record; and the author has compiled from the record a history which fairly bursts with anecdotes, quotes, and the great names of literature, art, exploration, natural science, and government.

Speaking of names, one thing this book brings home most sharply is the important part these outstanding personages have played in shaping general attitudes. Of course they were often too far ahead of their times—James Fenimore Cooper, for one (at this point the reviewer will take the liberty of singling out for emphasis the phase of the book which is central to the conservation theme). The frontier and sea stories for which Cooper is still known have obscured his ideas about nature. But to go even farther into the shadows, pointing out "ways to enjoy nature was only a minor purpose in Cooper's writings. What was far more important to him was the problem of balancing the household of nature. Cooper, of course, used no such word as 'conservation'; yet in building up the story of *The Pioneers* he employs the idea that man should govern the resources of nature by certain principles in order to conserve them. Chapter after chapter deals with man's waste of the treasures nature has provided him. When flocks of pigeons are being shot down wantonly, Leatherstocking is sure that 'the Lord won't see the waste of his creatures for nothing, and right will be done to the pigeons, as well as others, by and by.' . . . Above all, it is the woodchopper to whom Cooper makes an appeal. Forests are felled 'as if no end could be found to their treasures, nor any limits to their extent. If we go on this way, twenty years hence we shall want fuel'." In these two quotes from Cooper, Huth has revealed the seeds of nature conservancy and its ultimate expression, a century later, in Aldo Leopold's "land ethic."

Another conservation thinker-ahead-of-his-time Huth recognizes is George Catlin who is well enough known for his "powerful and telling texts" and "the work of his brush and drawing pencil" in reporting on the land west of the Mississippi and especially its Indians. At the same time, Huth emphasizes, "Catlin had the vision to see that the primeval glories of nature in this country could not last forever. At a time when the plains seemed as unfathomable as the ocean, when pastures and grazing lands had no boundaries, and no one believed that the forests could be exhausted, Catlin felt that, if future generations were to enjoy this rich heritage, it was necessary to conserve, not squander and destroy, these natural treasures. He knew that more than mere love of nature and devotion to it were needed if the national domain were to be preserved; men would have to take definite action to keep the great fortune which nature had given them in trust." Indeed it was George Catlin who in 1833 in a letter to a New York newspaper first gave voice to an idea which, when it began to catch on more than three decades later, became one of the main foundations of the world's conservation effort. Traveling up the Missouri River, Catlin was inspired by "the vast forests covering the banks" to "realize that these regions

> 'might in future be seen (by some great protecting policy of government) preserved in their pristine beauty and wildness, in a magnificent park, where the world could see for ages to come, the native Indian in his classic attire, galloping his wild horse . . . amid the fleeting herds of elks and buffaloes. What a beautiful and thrilling specimen for America to preserve and hold up to the view of her refined citizens and the world, in future ages. A *nation's Park* containing man and beast, in all the wild and freshness of their nature's beauty!'

Prophetic words, indeed, in regard to the national parks of a later day." Then in 1864, Yosemite, with Frederick Law Olmsted "the driving force behind this completely new idea of creating a park as a playground for the nation. . . ."

Not even with the national park idea, however, nor even with the resource conservation and, later, recreation policies which got the national forests launched under Gifford Pinchot, did the *wilderness* concept emerge. This was to be the idea that certain natural areas should be set aside and kept from even the recreational uses which in saturation began to threaten both parks and forests. This idea had to wait for an Aldo Leopold, and later a Robert Marshall; in the 1920's it was a new idea (although stemming, Huth reminds us, from the "thinking expressed in the works of Catlin, Emerson, and Thoreau"). It found in Aldo Leopold's "land ethic" teaching its highest moral justification. Man is a member of a biotic community, which includes all other animals, plants, water, and soil—all interdependent. Man is ethically and morally bound to obey and uphold the natural, biological laws which govern the working of this community. This is a long haul from the time of the unchecked broadax, when the only good

Grand Canyon veteran—ponderosa pine at South Rim. (Drawing by D.G.K.)

wilderness was a conquered one. The biotic community ideal is the preamble to the constitution governing the application of scientific values under which wilderness will henceforth, let us fervently hope, continue to exist—not only for the benefit of mankind but also for its own sake. It is no longer howling, but singing.

Wilderness of ages

Grand Canyon: *Today and all its yesterdays.* By Joseph Wood Krutch. William Sloane Associates, New York. 1958. 276 pp., frontispiece in full color, map, diagram. $5.00.

Among this reviewer's most cherished yesterdays are some summers full of them spent in the Grand Canyon and neighboring parts of northern Arizona and southern Utah. A book about the Grand Canyon country, therefore, to hit the mark, had to be like a portrait of a loved one—evocative, true to the spirit, in tune with intimate recollections, responsive to the most ineluctable feelings. It is safe to say that with his *Grand Canyon* Joseph Wood Krutch has hit the mark with most Canyon buffs who have read it, and also with many who have yet to discover the thing itself in all its mind-stunning reality. Most fortunate, perhaps, are those who came, or will have come to the Grand Canyon, mentally and spiritually prepared by the reading of this grand book.

Readers of *The Desert Year, The Voice of the Desert,* or any of Mr. Krutch's several books about the natural world, will happily find here the same qualities of mind and heart—the humility, the sanity, the sense of wonder, the boundless curiosity in search of facts—that mark the writer. He has possessed the world of nature and made it his own to explore, delight in, and interpret, as only a highly urbane and civilized person can. He has approached nature with the wisdom of a man of the world, and has let nature teach him.

No single thing can teach more about the way the earth works than the Grand Canyon. Here are lessons about the most distant past, the present, the future, and their geological inseparability; about the evolution of life; about the ever changing but ever continuous and interdependent community of living things. These lessons are read in the earth's most ancient rocks, exposed in the Colorado's inner gorge, in the successive rock layers—like volumes in a set of books—and in the living forests of the plateau through which the river has cut this mightiest of canyons. Nor has the author neglected the recent human history of the Grand Canyon—discovery, exploration, appreciation, habitation. Cárdenas, John Wesley Powell, John D. Lee, the Havasupai, naturalists, Park Service men, thousands of visitors—the Canyon's human story has had a large and varied cast and a lively action.

One of Mr. Krutch's mind and temper, in building his personal knowledge and understanding of nature, was bound to develop a compassion and concern for nature, especially for the living things that suffer most from the impact of man's exploitative and destructive urges, or his carelessness. His *Grand Canyon's* last chapter is a powerful tract on conservation, for the upholding of national park ideals, for the fostering of just such values as have called into being a continuing biennial wilderness conference.

"The wilderness and the idea of the wilderness," Mr. Krutch concludes, "is one of the permanent homes of the human spirit. . . . That most of (America) is no longer a wilderness is no cause for regret. . . . The frontier, so long an important influence on the temper of the American, no longer exists. But . . . the continent can still boast a spaciousness, a grandeur, a richness and a variety which a European can hardly imagine until he has seen it.

"These are things which other nations can never recover. Should we lose them, we could not recover them either. The generation now living may very well be that which will make the irrevocable decision whether or not America will continue to be for centuries to come the one great nation which had the foresight to preserve an important part of its heritage. . . ." D.G.K.

(Drawing by J. Yunge Bateman, courtesy of Coward-McCann, New York)

Grassroot wilderness

Lesser Worlds. By Nesta Pain. Illustrated by J. Yunge Bateman. Coward McCann, Inc., New York. 1958. viii + 244 pp., line drawings. $3.75.

An English science writer, Nesta Pain brings her own lively and incisive style to bear on well worked subject matter—life among the insects and spiders. She makes much reference to the work of classic predecessors on this literary ground—Fabre, Wheeler, Maeterlinck, even the sixteenth century arachnophile, Dr. Muffet, father of the little miss

who sat on a tuffet. The fact that the author of this book is reporting on the observations of others rather than on her own is not to be charged against the book. We need to be reminded every so often of what the great articulate observers have given us. A reinterpreter such as Nesta Pain can serve to send us back to the sources, for our greater intellectual enrichment, if not to the field, to see for ourselves what goes on at the grassroots level. A word should be said about Mr. Bateman's full-page drawings, which are in the crisp, meticulous style of the British school of wood-engravers, and a very pleasing embellishment of this book. D.G.K.

Peace or pieces

Our Nuclear Adventure: *Its possibilities and perils.* By D. G. Arnott. Philosophical Library, New York. 1958. 166 pp., 17 diagrams, index. $6.00.

A controversy which involves every one of us, whether we are aware of it or not, is presently being argued by a number of scientists in all parts of the world. The question is whether to test or not to test devices and weapons using nuclear explosions. The author of *Our Nuclear Adventure*, while being himself a proponent of the halting of bomb tests, points out that the testing of bombs at the present level presents no serious increase over the general background of natural sources of radio activity when averaged over the entire earth. The problem involved in man's experiments with devices which scatter radioactive wastes into the air and the sea is a more subtle one and is often lost in dissertations upon the evils of the bomb.

The effects of radioactive radiations upon humans can be divided into two categories, one somatic and the other genetic. The body shows definite thresholds of tolerance to radiation insofar as immediate effects are concerned, but there is no threshold whatsoever when one considers the effect of radiation upon the mutation rate. On this basis the obvious recommendation is for the elimination of any unnecessary sources of radiation.

The more subtle aspect of the problem is involved with the secrecy which is imposed by nations which are experimenting with nuclear weapons. The author points out the absurdity of trying to keep scientific truths under a cloak of national security. It only hampers research and repels capable men from research into a field which is destined to be the salvation of humanity as a source of power. The author attended the Geneva Conference of Atomic Scientists at which paper after paper delivered by scientists from many nations stated results of experiments which agreed precisely. Truth is truth, and any diligent effort toward it, regardless of the part of the world in which the worker lives, will lead to the same facts and conclusions.

Responsibility for decisions regarding the explosions of bombs cannot be delegated by the scientist to the shoulders of political dealers. Decisions regarding nuclear energy cannot be made wisely by men of politics, for they are not necessarily wise in such matters, nor are their decisions democratically controlled. The common man, more and more, is taking a vacation from responsibility. The reversal of this trend is the most important task of our age. It is the responsibility of the scientist not only to inform his fellow men regarding issues in the application of science, but to make known his own opinions and recommendations. *Our Nuclear Adventure* is dedicated to this idea.

The author opens his text with a thorough discussion of just what atomic energy is and how it is derived. He discusses the three types of bombs, comparing their energy and the resulting fall-out. There follows a discussion of the physiological effects of radiation, the final episode of the darker side of nuclear energy. The latter part of the book is devoted to the peaceful use of atomic energy and the importance of international coöperation and control. The material is authentic insofar as the basic science is concerned and one may assume that the rest of the data presented are as accurate as the basic science. Mr. Arnott is a worker in nuclear physics himself, in the British Isles where atomic energy is used for power to a greater extent than anywhere else in the world. G.W.B.

Gnomon is an island

Dictionary of Astronomy and Astronautics. By Armand Spitz and Frank Gaynor. Philosophical Library, Inc., New York. 1958. 439 pp., 16 plates. $6.00.

Science teachers, astronomers (professional and amateur), and space travel enthusiasts will find this book a welcome addition to their bookshelves. It won't stay long on the shelf, either, for its clear definitions of some 2,200 terms in the field of astronomy and astronautics are remarkably comprehensive and concise. There has been a need for a dictionary of astronomy for many years, and this book is an excellent reference.

Taking a few terms at random in the book we find definitions for: gnomon, pulsating star, cosmic egg, bipropellant rocket, tidal friction, ion rocket, negative eyepiece, and "flying saucer."

Beside the definitions, the book has sixteen plates of astronomical photographs and useful astronomical tables and constants.

Even the cross-word puzzle enthusiast will find this book a *must* for his work. C.F.H.

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The first volumes of the series cover the ten-county region surrounding San Francisco Bay. However, since this area includes part of the Central Valley, the guides are useful throughout most of Northern California.

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By WILLIAM D. AND ELIZABETH BERRY, discusses the most common Bay region land mammals, indicating noteworthy behavior characteristics, field identification points, habitats, number of young, and food. The illustrations were drawn from life—the authors live-trapped and kept in captivity many of the smaller species, to observe more closely their habits and appearance. Suggestions for activities such as track-casting are given. A check list is included for all Bay area mammals, including several of rare occurrence. 72 pages, 68 text illustrations, 8 pages in color, 2 maps, $1.50.

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"Doorstep Botany in San Francisco"

EDITOR, *Pacific Discovery:*

I write to congratulate you on the interesting and informative article "Doorstep Botany in San Francisco" (January-February 1959). For several years I have been teaching a course here at USF in the History of San Francisco and I have endeavored to point out some of the attractive features of this city. However, since the "ars botanica" is almost completely unknown to me, I was ignorant of this facet of our city until looking at this splendid album of photographs and commentary on this phase of local history and current interest. I thought you and those who did this article and photographic layout should have these few sincere words of praise. I hope that you will continue to point out other similar phases of the San Francisco Story.

(REV.) JOHN B. MCGLOIN, S.J.
Associate Professor of History

University of San Francisco,
San Francisco, 21 February 1959.

"Sierra Club Bulletin"

EDITOR, *Pacific Discovery:*

This is a note of appreciation for the congratulatory message in "Pre-Discovery" in your January-February issue. It was most kind and thoughtful of you to thus express your praise for the new format of the *Sierra Club Bulletin*, and we are all very grateful.

Of course you could not know it, but the one named omitted in your listing from editors to printer was that of David Brower, Executive Director of the Sierra Club, who instigated and carried through the change which is such a big step-up for the *Bulletin*, and who gave us invaluable direction and help in putting together that first issue. He has done the same for the February number, now on the press.

May I add a word of commendation for your own very handsome publication? I am particularly enthusiastic about "Doorstep Botany in San Francisco," with its individual and characteristic contributions from Tom Howell and Charles Townsend. It is delightful, and should literally be an eye-opener.

VIVIAN SCHAGEN
Editor, Monthly *Bulletin*
Sierra Club, San Francisco, 28 February 1959.

DAVE BROWER'S *and our inky paths crossed frequently in the Gillick composing room during* PD's *earlier years. When Dave moved up to the executive position in the Sierra Club which he has held with international distinction for a number of years now, his heart surely stayed very close to the* Bulletin *he edited till then; and the other fine editors who have followed him have never let him down. Kudos all around!*—ED.

"The Third Moriah"

THE *following letter was addressed in the original to our author, Weldon F. Heald:*

DEAR MR. HEALD:

Am deeply thrilled by your article "The Third Moriah" in the current number of *Pacific Discovery*. Is it not a good backfire against the one in *American Forests*? C. M. GOETHE

Sacramento, California, 2 February 1959.

We'll try to

EDITOR, *Pacific Discovery:*

We all certainly enjoy your fine, informative, and exceedingly interesting magazine. As a teacher I have recommended it to many of my associates. Keep up the good work.

MARGUERITE (MRS. L. D.) MASTERS
Belmont, California, 22 January 1959.

Johan Kooy, artist in the Academy Exhibits Department, at work on the Sierra wilderness diorama. (Photo by Toshio Asaeda of Exhibits)

academically speaking

YEARS AGO, when proponents of preserving our wilderness areas were first launching their efforts, they decided they needed a definition for a wilderness area on which all could agree. The decision and the definition were destined never to meet. The issue came up again and again and many hours of discussion were devoted to reaching a common definition.

After a time, the wilderness proponents agreed to disagree, as far as a definition for a wilderness area was concerned. They soon realized that there would always be just as many definitions as there were individuals trying to define it.

Each individual has a different reason for visiting a wilderness area, just as each person reaches a different interpretation of the significance of a wilderness area when he looks upon it. And upon returning to civilization, each one of us carries a different idea of what the wilderness contained.

A biologist sees the ecology of the region; a geologist's eye is captured by the rock formations; the serenity of an area practically untouched by man captivates the artist; a botanist will immediately turn to the myriad species of plants; a fisherman sees the streams, and a hunter sees the game.

For this reason, the exhibit which is a feature of the Sixth Biennial Wilderness Conference, convening March 20 and 21 at the Fairmont Hotel here in San Francisco, displays a wilderness area on which no eye, human or otherwise, will ever gaze.

Part of the exhibit is a painted diorama of a hypothetical wilderness area, stylized to please the eyes of many persons, but no one more than another. The area depicted in the diorama is a composite of the flora, fauna, geology and beauty that might be found in a thousand places in North America. The other section of the exhibit consists of a screen for the projection of color slides. When a button is pressed at the bottom of the screen, the viewer gets an ever better look at the components of a wilderness area.

The button triggers a series of 48 colored slides, each one of which features a different facet of a wilderness area. As the slides are projected on the screen, they are synchronized with a taped narration. The narration takes up the story of the hypothetical area, describing its birds, animals, plants, geologic formations, and points out why such an area is so important to scientists and laymen alike. As the slides and the narration run their 13-minute course, the viewer becomes doubly aware of why our wilderness areas, as the last remnants of original America, must be preserved. As the narration concludes; "Is this living history worth preserving? It's up to you."

The exhibit, which after the conference is destined to become one of the permanent exhibits in the Academy's Alice Eastwood Hall of Botany, is the work of many people. It grew out of a survey of the flora, fauna, and geology of the Sadler Lake area of the High Sierra made last year by Dr. Robert T. Orr, Curator of Birds and Mammals; Ivan Tarnowsky, of the Sierra Club; the late Cecil Tose, former Curator of Exhibits; John Thomas Howell, Curator of Botany; Douglass Hubbard, of the National Park Service, and Ralph Walton of the U. S. Forest Service.

Dr. Orr was coördinator of the exhibit, and Ernest Rook was designer. The diorama was painted by Johan Kooy and most of the slides were taken by Dr. Orr and James MacBride, with the remainder obtained through the cooperation of Mrs. Mary V. Hood of the Los Angeles Audubon Society. Freda McCaig and Richard Cook wrote the narration and Sierra Club members Ivan Tarnowsky and Oliver Kehrlein were in on almost every phase of the project.

Others to whom much credit is due are, in alphabetical order, Toshio Asaeda, George Bunton, A. S. Getten, Al Gundred, Charles Hagar, Ed Harris, Velma Harris, Frank Kreighbaum, and Ray Strong.

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